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LG Display

LC840EQD

Product Specification

SPECIFICATION
FOR
APPROVAL

(●) **Preliminary Specification**

( ) **Final Specification**

Title	84.0" QWUXGA TFT LCD

BUYER	General
MODEL	

SUPPLIER	LG Display Co., Ltd.
*MODEL	LC840EQD
SUFFIX	SEM1 (RoHS Verified)

*When you obtain standard approval,
please use the above model name without suffix

APPROVED BY	SIGNATURE DATE
/	
/	
/	

Please return 1 copy for your confirmation with your signature and comments.

APPROVED BY	SIGNATURE DATE
S.K.Park / Team Leader	
REVIEWED BY	
S.W. Yu / Project Leader	
PREPARED BY	
K.H.Jang / Engineer	

TV Product Development Dept.
LG Display Co., Ltd.

Ver. 1.0

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Product Specification

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RECORD OF REVISIONS

Revision No.	Revision Date	Page	Description
0.1	Mar, 30, 2012	-	Preliminary Specification (First Draft)
0.2	July.16.2012	3,5,6	Update the power consumption
		3,21	Update the information of weight
		13	Delete The intra pair skew
		15	Update the power sequence(Delete Vcm ot the interface sigmal)
		17	Update the optical Spec.
		22,23	Update the mechanical drawing
		26,29	Update the information of packing
0.3	Aug.02.2012	22,23	Update the mechanical drawing
1.0	Aug.02.2012	-	CAS Version 1.0 Release
		-	**Final Specification**

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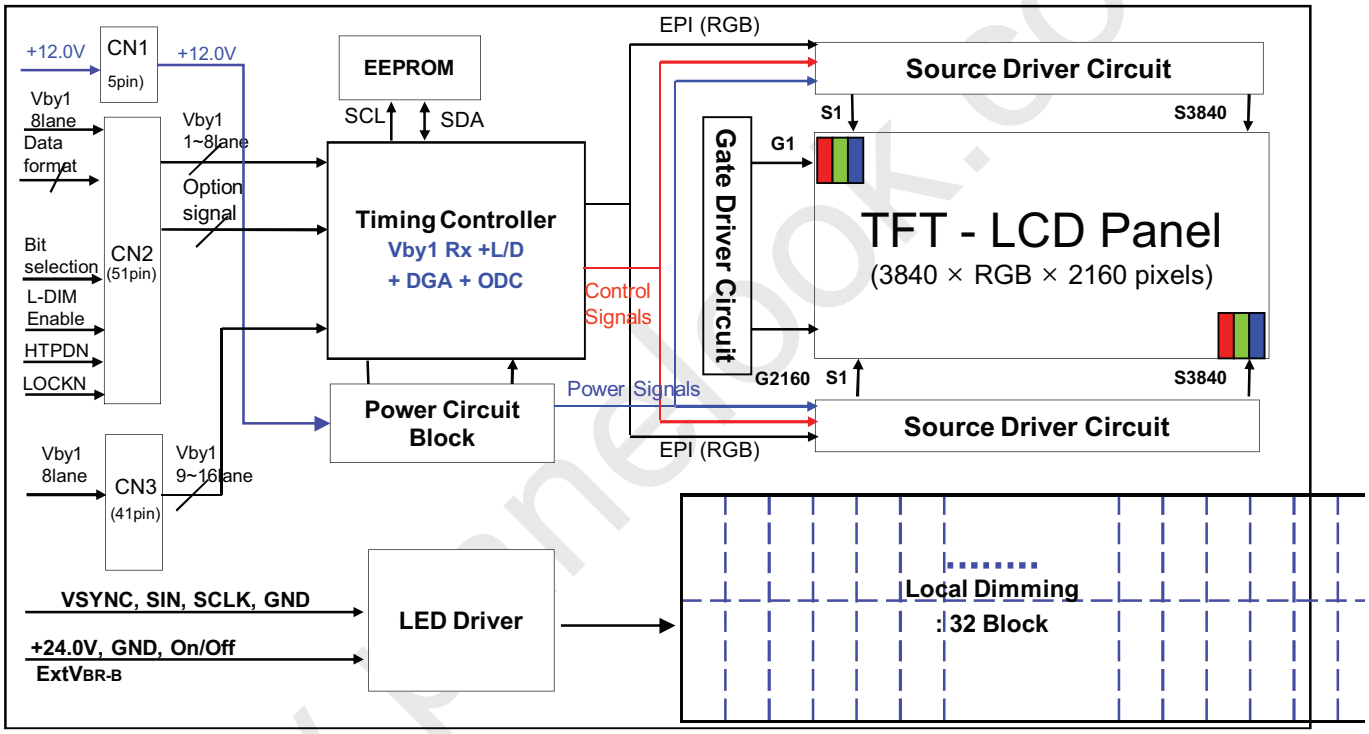
1. General Description

The LC840EQD is a Color Active Matrix Liquid Crystal Display with an integral Light Emitting Diode (LED) backlight system. The matrix employs a-Si Thin Film Transistor as the active element. It is a transmissive display type which is operating in the normally black mode. It has a 84.04 inch diagonally measured active display area with QWUXGA resolution (2160 vertical by 3840 horizontal pixel array). Each pixel is divided into Red, Green and Blue sub-pixels or dots which are arrayed in vertical stripes. Gray scale or the luminance of the sub-pixel color is determined with a 10-bit gray scale signal for each dot. Therefore, it can present a palette of more than 1.06Bilion colors.
It has been designed to apply the 10-bit 16 Lane V by One interface.
It is intended to support LCD TV, PCTV where high brightness, super wide viewing angle, high color gamut, high color depth and fast response time are important.



Active Screen Size	84.04 inches(2134.62 mm) diagonal
Outline Dimension	1904.0(H) × 1096.0(V) X 15.5(B) /24.0 mm(D) (Typ.)
Pixel Pitch	0.4845 mm x 0.4845 mm
Pixel Format	3840 horiz. by 2160 vert. Pixels, RGB stripe arrangement
Color Depth	10bit(D), 1.06Billon colors
Luminance, White	350 cd/m^2 (Center 1point ,Typ.)
Viewing Angle (CR>10)	Viewing angle free (R/L 178 (Min.), U/D 178 (Min.))
Power Consumption	Total 398W (Typ.) [Logic= 18W, LED Driver=380W (ExtVbr_B=100%)]
Weight	42.9 Kg (Typ.)
Display Mode	Transmissive mode, Normally black
Surface Treatment	Hard coating(3H), Anti-glare treatment of the front polarizer (Haze 10%)

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2. Absolute Maximum Ratings

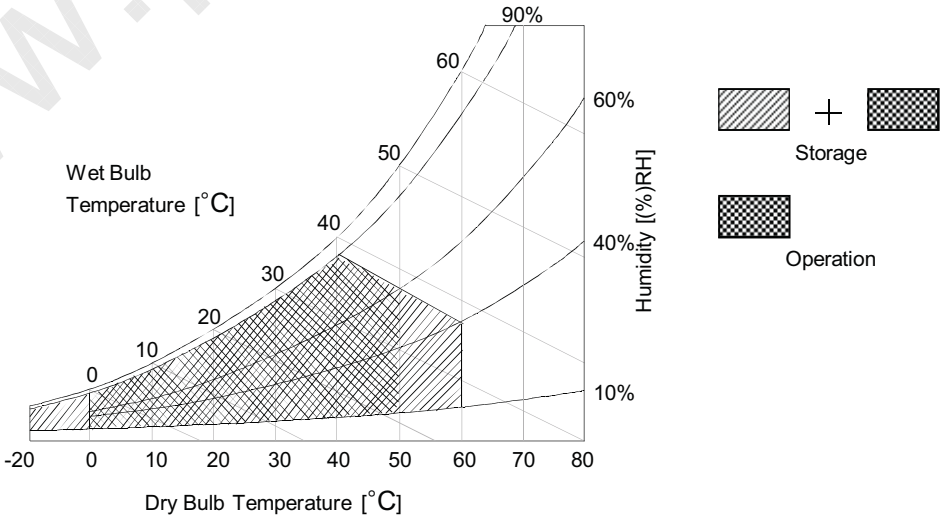
The following items are maximum values which, if exceeded, may cause faulty operation or permanent damage to the LCD module.

Table 1. ABSOLUTE MAXIMUM RATINGS

Parameter		Symbol	Value		Unit	notes
			Min	Max		
Power Input Voltage	LCD Circuit	V_{LCD}	-0.3	+14.0	V_{DC}	1
	Driver	V_{BL}	-0.3	+ 27.0	V_{DC}	
Driver Control Voltage	ON/OFF	V_{OFF} / V_{ON}	-0.3	+5.5	V_{DC}	
	Brightness	**EXTV**$_{BR-B}$	0.0	+5.5	V_{DC}	
T-Con Option Selection Voltage		V_{LOGIC}	-0.3	+4.0	V_{DC}	
Operating Temperature		T_{OP}	0	+50	°C	2,3
Storage Temperature		T_{ST}	-20	+60	°C	
Panel Front Temperature		T_{SUR}	-	+68	°C	4
Operating Ambient Humidity		H_{OP}	10	90	%RH	2,3
Storage Humidity		H_{ST}	10	90	%RH	

notes :1. Ambient temperature condition (Ta = 25 ± 2 °C)

2. Temperature and relative humidity range are shown in the figure below.
   Wet bulb temperature should be Max 39°C, and no condensation of water.
3. Gravity mura can be guaranteed below 40°C condition.
4. The maximum operating temperatures is based on the test condition that the surface temperature of display area is less than or equal to 68°C with LCD module alone in a temperature controlled chamber. Thermal management should be considered in final product design to prevent the surface temperature of display area from being over 68℃. The range of operating temperature may be degraded in case of improper thermal management in final product design.



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3. Electrical Specifications

3-1. Electrical Characteristics

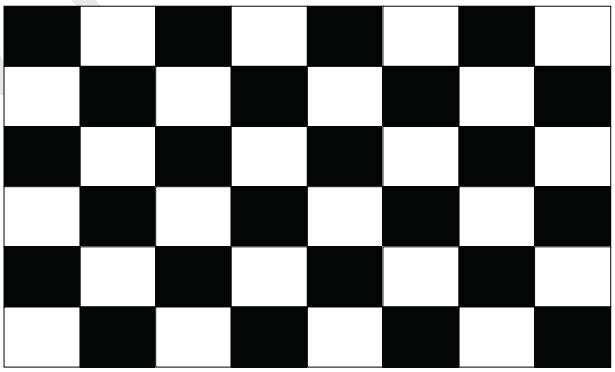
It requires two power inputs. One is employed to power for the LCD circuit. The other Is used for the LED backlight and LED Driver circuit.

Table 2. ELECTRICAL CHARACTERISTICS

Parameter	Symbol	Value			Unit	notes
		Min	Typ	Max		
Circuit :						
Power Input Voltage	V_{LCD}	10.8	12.0	13.2	V_{DC}	
Power Input Current	I_{LCD}	-	1500	1950	mA	1
		-	4400	5720	mA	2
Power Consumption	P_{LCD}	-	18.0	23.4	Watt	1
Rush current	I_{RUSH}	-	-	8.0	A	3

notes : 1. The specified current and power consumption are under the V_{LCD}=12.0V, Ta=25 ± 2°C, f_V=120Hz condition, and mosaic pattern(8 x 6) is displayed and f_V is the frame frequency.
2. The current is specified at the maximum current pattern.
3. The duration of rush current is about 2ms and rising time of power input is 0.5ms (min.).
4. Ripple voltage level is recommended under ±5% of typical voltage

White : 1023 Gray
Black : 0 Gray



Mosaic Pattern(8 x 6)

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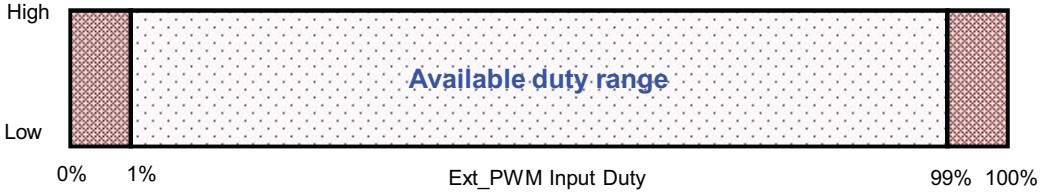
Table 3. ELECTRICAL CHARACTERISTICS (Continue)

Parameter			Symbol	Driver Board	Values			Unit	Notes
					Min	Typ	Max		
LED Driver :									
Power Supply Input Voltage			VBL		22.8	24.0	25.2	Vdc	1
Power Supply Input Current			IBL	Left	-	7.9	8.5	A	1
				Right		7.9	8.5		
Power Supply Input Current (In-Rush)			In-rush	Left	-	-	10.7	A	VBL = 22.8V ExtVBR-B=100% 4
				Right	-	-	10.7		
Power Consumption (Total)			PBL	Left	-	190	204	W	1
				Right	-	190	204		
Input Voltage for Control System Signals	On/Off	On	V on		2.5	-	5.0	Vdc	
		Off	V off		-0.3	0.0	0.7	Vdc	
	Brightness Adjust		ExtVBR-B		1	-	100	%	On Duty 6
	PWM Frequency for NTSC & PAL		PAL			100		Hz	3
			NTSC			120		Hz	3
	Pulse Duty Level (PWM)		HighLevel		2.5	-	3.6	Vdc	HIGH : on duty LOW : off duty
			Low Level		0.0	-	0.7	Vdc	
LED :									
Life Time					30,000	50,000		Hrs	2

Notes :

1. Electrical characteristics are determined after the unit has been 'ON' and stable for approximately 60 minutes at 25±2°C. The specified current and power consumption are under the typical supply Input voltage 24Vand V_{BR} ($Ext V_{BR-B}$: 100%), it is total power consumption.
2. The life time (MTTF) is determined as the time which luminance of the LED is 50% compared to that of initial value at the typical LED current (ExtVBR-B :100%) on condition of continuous operating in LCM state at 25±2°C.
3. LGD recommend that the PWM freq. is synchronized with One time harmonic of V_sync signal of system. Though PWM frequency is over 120Hz (max 252Hz), function of LED Driver is not affected.
4. The duration of rush current is about 200ms. This duration is applied to LED on time
5. Even though inrush current is over the specified value, there is no problem if I^2T spec of fuse is satisfied.
6. Ext_PWM Signal have to input available duty range.
   Between 99% and 100% $Ext V_{BR-B}$ duty have to be avoided. (99% < $Ext V_{BR-B}$ < 100%)
   But $Ext V_{BR-B}$ 0% and 100% is possible.



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3-2. Interface Connections

This LCD module employs theree kinds of interface connection, 5-pin connector, 51-pin connector and 41-pin connector are used for the module electronics and 14-pin,12-pin connector is used for the integral backlight system.

3-2-1. LCD Module

- LCD Connector(CN1): SM05B-PASS-TB(manufactured by JST)
- Mating Connector : PAP-05V-S(JST) or compatible

Table 4-1. MODULE CONNECTOR(CN1) PIN CONFIGURATION

No	Symbol	Description
1	GND	Ground
2	GND	Ground
3	VLCD	Power Supply +12.0V
4	VLCD	Power Supply +12.0V
5	VLCD	Power Supply +12.0V

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- LCD Connector(CN1): FI-RE51S-HF(manufactured by JAE)
- Mating Connector : FI-R51HL(JAE) or compatible

Table 4-2. MODULE CONNECTOR(CN2) PIN CONFIGURATION

No	Symbol	Description	No	Symbol	Description
1	NC (Reserved)	Power Supply +12.0V (reserved)	27	GND	Ground
2	NC (Reserved)	Power Supply +12.0V (reserved)	28	Rx0n	V-by-One HS Data Lane 0
3	NC (Reserved)	Power Supply +12.0V (reserved)	29	Rx0p	V-by-One HS Data Lane 0
4	NC (Reserved)	Power Supply +12.0V (reserved)	30	GND	Ground
5	NC (Reserved)	Power Supply +12.0V (reserved)	31	Rx1n	V-by-One HS Data Lane 1
6	NC (Reserved)	Power Supply +12.0V (reserved)	32	Rx1p	V-by-One HS Data Lane 1
7	NC (Reserved)	Power Supply +12.0V (reserved)	33	GND	Ground
8	NC (Reserved)	Power Supply +12.0V (reserved)	34	Rx2n	V-by-One HS Data Lane 2
9	NC	NO CONNECTION (notes 4)	35	Rx2p	V-by-One HS Data Lane 2
10	GND	Ground	36	GND	Ground
11	GND	Ground	37	Rx3n	V-by-One HS Data Lane 3
12	GND	Ground	38	Rx3p	V-by-One HS Data Lane 3
13	GND	Ground	39	GND	Ground
14	GND	Ground	40	Rx4n	V-by-One HS Data Lane 4
15	Data format 0	Input Data Format [1:0] : '00'=Mode1, '01'=Mode2, '10'=Mode3, '11'=Mode4	41	Rx4p	V-by-One HS Data Lane 4
16	Data format 1		42	GND	Ground
17	NC	NO CONNECTION (notes 4)	43	Rx5n	V-by-One HS Data Lane 5
18	NC	NO CONNECTION (notes 4)	44	Rx5p	V-by-One HS Data Lane 5
19	NC	NO CONNECTION (notes 4)	45	GND	Ground
20	NC	NO CONNECTION (notes 4)	46	Rx6n	V-by-One HS Data Lane 6
21	Bit SEL	'H' or NC= 10bit(D) , 'L' = 8bit	47	Rx6p	V-by-One HS Data Lane 6
22	L-DIM Enable	'H' = Enable , 'L' or NC = Disable	48	GND	Ground
23	GND	Ground (notes 7)	49	Rx7n	V-by-One HS Data Lane 7
24	GND	Ground	50	Rx7p	V-by-One HS Data Lane 7
25	HTPDN	Hot plug detect	51	GND	Ground
26	LOCKN	Lock detect	-	-	-

notes
1. All GND (ground) pins should be connected together to the LCD module's metal frame.
2. #1~#8 NC (No connection) : These pins are used for back up power source, V_{LCD} (power input) . These pins are should be connected together.
3. All Input levels of V-by-One signals are based on the V-by-One HS Standard Version 1.3.
4. #9 & #17~#20 NC (No Connection) : These pins are used only for LGD (Do not connect)
5. Specific pin (**#22**) is used for Local Dimming function of the LCD module. If not used, these pins are no connection. (Please see the **Appendix IV-2** for more information.)
6. About spcific pin (#15,#16) , Please see the **Appendix VII**.
7. Specific pin No. **#23** is used for "No signal detection" of system signal interface. It should be GND for NSB (No Signal Black) while the system interface signal is not. If this pin is "H" or "NC", LCD Module displays AGP (Auto Generation Pattern).

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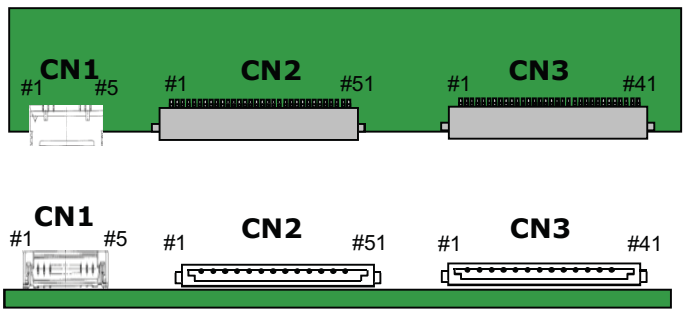
-LCD Connector (CN2) : FI-RE41S-HF (manufactured by JAE)
- Mating Connector : FI-RE41HL or compatible

Table 4-3. MODULE CONNECTOR(CN3) PIN CONFIGURATION

No	Symbol	Description	No	Symbol	Description
1	GND	Ground	22	GND	Ground
2	Rx8n	V-by-One HS Data Lane 8	23	Rx15n	V-by-One HS Data Lane 15
3	Rx8p	V-by-One HS Data Lane 8	24	Rx15p	V-by-One HS Data Lane 15
4	GND	Ground	25	GND	Ground
5	Rx9n	V-by-One HS Data Lane 9	26	NC	NO CONNECTION
6	Rx9p	V-by-One HS Data Lane 9	27	NC	NO CONNECTION
7	GND	Ground	28	NC	NO CONNECTION
8	Rx10n	V-by-One HS Data Lane 10	29	NC	NO CONNECTION
9	Rx10p	V-by-One HS Data Lane 10	30	NC	NO CONNECTION
10	GND	Ground	31	NC	NO CONNECTION
11	Rx11n	V-by-One HS Data Lane 11	32	NC	NO CONNECTION
12	Rx11p	V-by-One HS Data Lane 11	33	NC	NO CONNECTION
13	GND	Ground	34	NC	NO CONNECTION
14	Rx12n	V-by-One HS Data Lane 12	35	NC	NO CONNECTION
15	Rx12p	V-by-One HS Data Lane 12	36	NC	NO CONNECTION
16	GND	Ground	37	NC	NO CONNECTION
17	Rx13n	V-by-One HS Data Lane 13	38	NC	NO CONNECTION
18	Rx13p	V-by-One HS Data Lane 13	39	NC	NO CONNECTION
19	GND	Ground	40	NC	NO CONNECTION
20	Rx14n	V-by-One HS Data Lane 14	41	NC	NO CONNECTION
21	Rx14p	V-by-One HS Data Lane 14	-		

notes : 1. All GND (ground) pins should be connected together to the LCD module's metal frame.
2. #26~#41 NC (No Connection) : These pins are used only for LGD (Do not connect)



Rear view of LCM

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3-2-2. Backlight Module

Master

-LED Driver Connector

: 20022WR - H14B2(Yeonho) , 20022WR-H12B2(Yeonho)

- Mating Connector

: 20022HS-H14B2(Yeonho),20022HS-H12B2(Yeonho) or Compatible

Table 5-1. LED DRIVER CONNECTOR PIN CONFIGURATION

Pin No	Symbol	Description (CN_A1/CN_A2)	Description (CN_A2/CN_B2)	Note
1	VBL	Power Supply +24.0V	Power Supply +24.0V	
2	VBL	Power Supply +24.0V	Power Supply +24.0V	
3	VBL	Power Supply +24.0V	Power Supply +24.0V	
4	VBL	Power Supply +24.0V	Power Supply +24.0V	
5	VBL	Power Supply +24.0V	Power Supply +24.0V	
6	GND	Backlight Ground	Backlight Ground	
7	GND	Backlight Ground	Backlight Ground	
8	GND	Backlight Ground	Backlight Ground	1
9	GND	Backlight Ground	Backlight Ground	
10	GND	Backlight Ground	Backlight Ground	
11	Status	Backlight Status	Don't care	2
12	VON/OFF	Backlight ON/OFF control	Don't care	
13	NC	Don't care		
14	EXTVBR_B	External PWM		3

notes : 1. GND should be connected to the LCD module's metal frame.

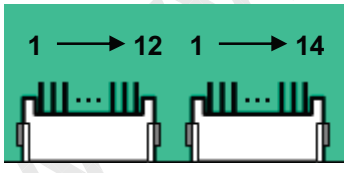
2. Normal : Low (under 0.7V) / Abnormal : Open

3. High : on duty / Low : off duty, Pin#14 can be opened. (if Pin #14 is open , EXTVBR-B is 100%)

4. Each impedance of pin #12 and 14 is over 50 [KΩ] .

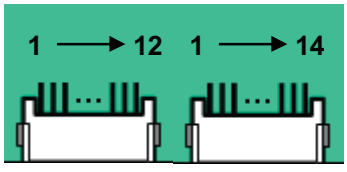
◆ Rear view of LCM

Board B

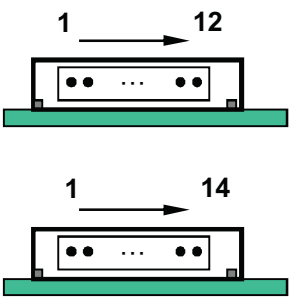


CN_B2 **CN_B1**

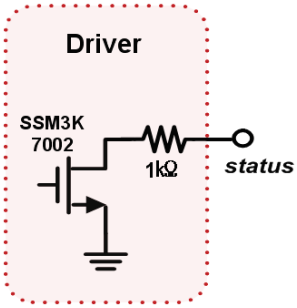
Board A



CN_A2 **CN_A1**



◆ Status



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3-3. Signal Timing Specifications

Table 6 shows the signal timing required at the input of the LVDS transmitter. All of the interface signal timings should be satisfied with the following specification for normal operation.

Table 6. TIMING TABLE (DE Only Mode)

ITEM		Symbol	Min	Typ	Max	Unit	Note
Horizontal	Display Period	t_{HV}	240	240	240	t_{CLK}	3840/16
	Blank	t_{HB}	25	35	60	t_{CLK}	1
	Total	t_{HP}	265	275	300	t_{CLK}	
Vertical	Display Period	t_{VV}	2160	2160	2160	Lines	
	Blank	t_{VB}	40 (456)	90 (540)	172 (600)	Lines	1
	Total	t_{VP}	2200 (2616)	2250 (2700)	2332 (2760)	Lines	

ITEM		Symbol	Min	Typ	Max	Unit	Note
Frequency	DCLK	f_{CLK}	67	74.25	78.00	MHz	1188/16
	Horizontal	f_H	244	270	280	KHz	1
	Vertical	f_V	108 (95)	120 (100)	122 (104)	Hz	2 NTSC (PAL)

notes: 1. The input of HSYNC & VSYNC signal does not have an effect on normal operation (DE Only Mode). If you use spread spectrum of EMI, add some additional clock to minimum value for clock margin.

2. The performance of the electro-optical characteristics may be influenced by variance of the vertical refresh rate and the horizontal frequency

※ Timing should be set based on clock frequency.

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3-4. V by One input signal Characteristics

3-4-1. V by One Input Signal Timing Diagram

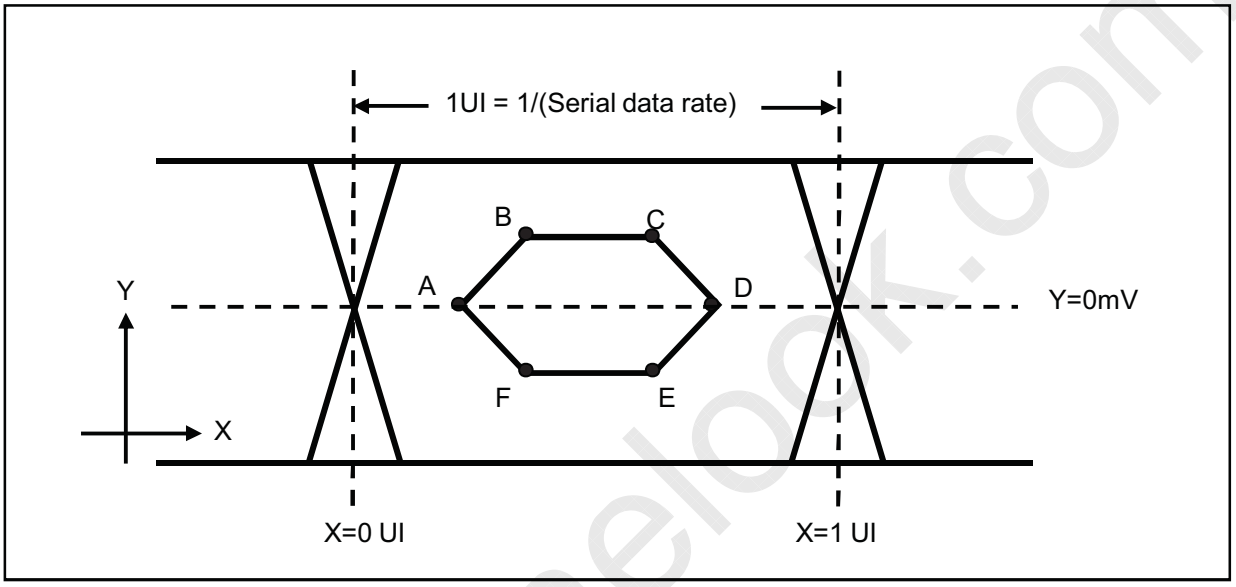

Table7. Eye Mask Specification

	X[UI]	Note	Y[mV]	Note
A	0.25 (max)	2	0	-
B	0.3 (max)	2	50	3
C	0.7(min)	3	50	3
D	0.75(min)	3	0	-
E	0.7(min)	3	I -50 I	3
F	0.3(max)	2	I -50 I	3

notes 1. All Input levels of V by One signals are based on the V by One HS Standard Ver. 1.3
2. This is allowable maximum value.
3. This is allowable minimum value.
4. The eye diagram is measured by the oscilloscope and receiver CDR characteristic must be emulated.
- PLL bandwidth : 11 Mhz
- Damping Factor : 1

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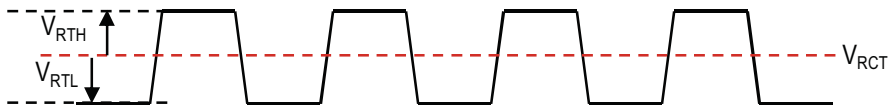
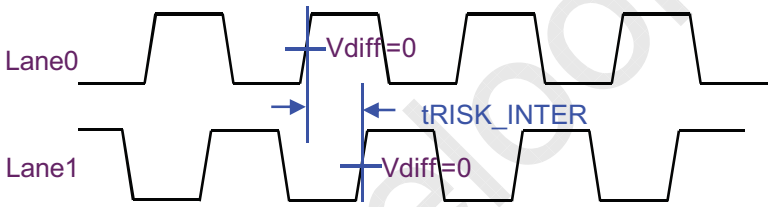
3-4-2. V by One Input Signal Characteristics

1) DC Specification

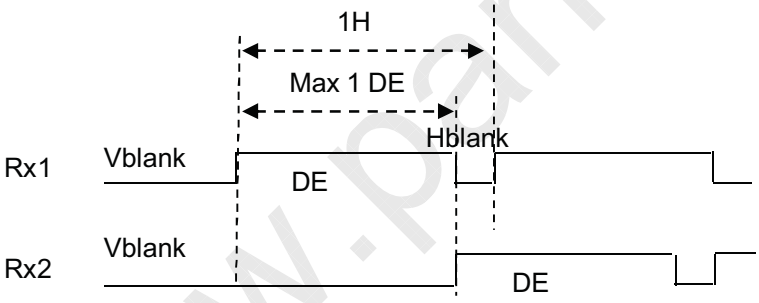


Description	Symbol	Min	Max	Unit	notes
CML Differential input High threshold	V_{RTH}	-	50	mV	-
CML Differential input Low threshold	V_{RTL}	-50	-	mV	-
CML Common mode Bias Voltage	V_{RCT}	0.6	0.8	V	-

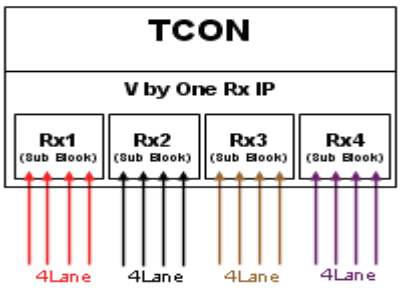
2) AC Specification



<Inter-pair Skew between two Lanes>



<Inter-pair Skew between two sub Blocks>



<TCON – VbyOne Brief Diagram >

Description	Symbol	Min	Max	Unit	notes
Allowable inter-pair skew between lanes	tRISK_INTER	-	5	UI	1,3
Allowable iner-pair skew between sub-blocks	tRISK_BLOCK	-	1	DE	1,4

Notes 1.1UI = 1/serial data rate

2. it is the time difference between the true and complementary single-ended signals.
3. it is the time difference of the differential voltage between any two lanes in one sub block.
4. it is the time difference of the differential voltage between any two blocks in one IP.

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3-5. Color Data Reference

The brightness of each primary color (red, green, blue) is based on the 10bit or 8bit gray scale data input for the color. The higher binary input, the brighter the color. Table 8 provides a reference for color versus data input.

Table 8. COLOR DATA REFERENCE

Packer input & Unpacker output		30bpp RGB (10bit)	24bpp RGB (8bit)
Byte0	D[0]	R[2]	R[0]
	D[1]	R[3]	R[1]
	D[2]	R[4]	R[2]
	D[3]	R[5]	R[3]
	D[4]	R[6]	R[4]
	D[5]	R[7]	R[5]
	D[6]	R[8]	R[6]
	D[7]	R[9]	R[7]
Byte1	D[8]	G[2]	G[0]
	D[9]	G[3]	G[1]
	D[10]	G[4]	G[2]
	D[11]	G[5]	G[3]
	D[12]	G[6]	G[4]
	D[13]	G[7]	G[5]
	D[14]	G[8]	G[6]
	D[15]	G[9]	G[7]
Byte2	D[16]	B[2]	B[0]
	D[17]	B[3]	B[1]
	D[18]	B[4]	B[2]
	D[19]	B[5]	B[3]
	D[20]	B[6]	B[4]
	D[21]	B[7]	B[5]
	D[22]	B[8]	B[6]
	D[23]	B[9]	B[7]
Byte3	D[24]	Don't care	
	D[25]	Don't care	
	D[26]	B[0]	
	D[27]	B[1]	
	D[28]	G[0]	
	D[29]	G[1]	
	D[30]	R[0]	
	D[31]	R[1]	

Notes 1. 30bpp RGB (10bit) is 4 byte mode, otherwise (24bpp RGB) 3byte mode

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3-6. Power Sequence

3-6-1. LCD Driving circuit

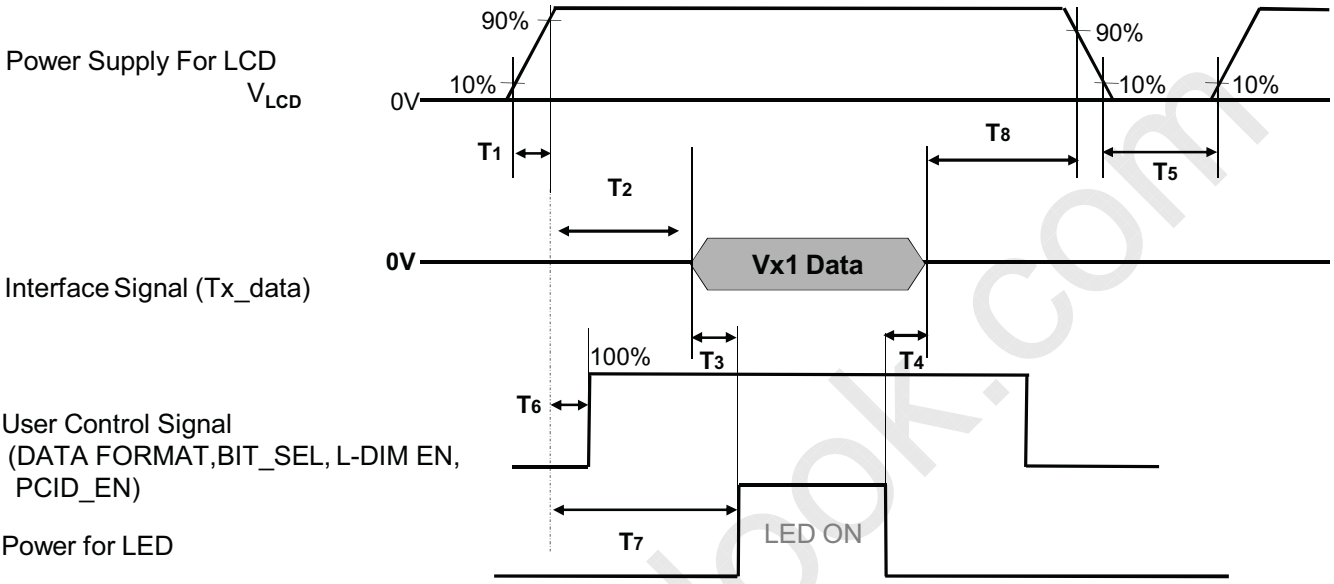

Table 9. POWER SEQUENCE

Parameter	Value			Unit	notes
	Min	Typ	Max		
T1	0.5	-	20	ms	1
T2	0	-	-	ms	2
T3	200	-	-	ms	3
T4	200	-	-	ms	3
T5	1.0	-	-	s	4
T6	-	-	T2	ms	5
T7	0.5	-	-	s	6
T8	100	-	-	ms	7

notes :
1. Even though T1 is over the specified value, there is no problem if I2T Spec. of fuse is satisfied.
2. If T2 is satisfied with specification after removing V-by-One Cable, there is no problem.
3. The T3 / T4 is recommended value, the case when failed to meet a minimum specification, abnormal display would be shown. There is no reliability problem.
4. T5 should be measured after the Module has been fully discharged between power off and on period.
5. If the on time of signals (Interface signal and user control signals) precedes the on time of Power (V_{LCD}), it will be happened abnormal display. When T6 is NC status, T6 doesn't need to be measured.
6. If there is no abnormal display, no problem.
7. It is recommendation specification that T8 has to be 100ms as a minimum value.

※ Please avoid floating state of interface signal at invalid period.
※ When the power supply for LCD (VLCD) is off, be sure to pull down the valid and invalid data to 0V.
※ There is no problem even though LOCKN/HTPDN Signal is on before T1.

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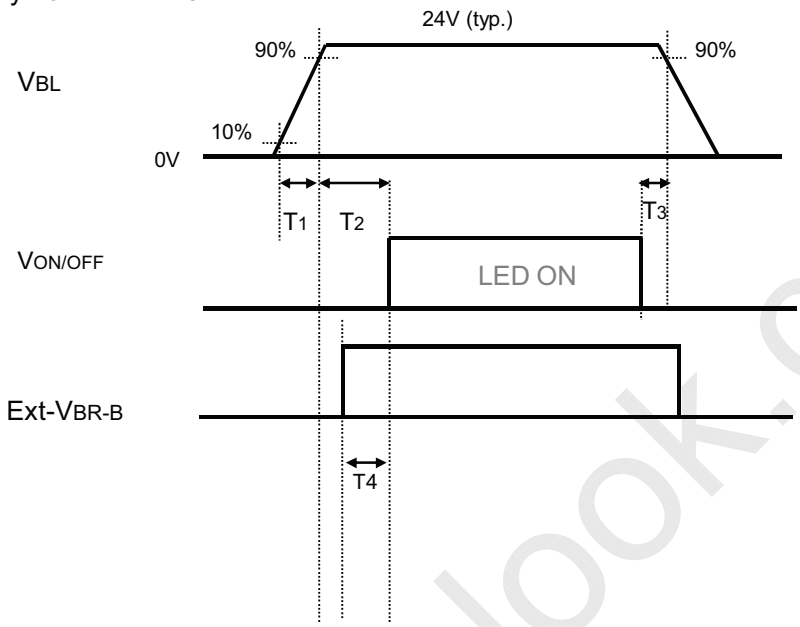
3-6-2. Sequence for LED Driver

Power Supply For LED Driver



3-6-3. Dip condition for LED Driver

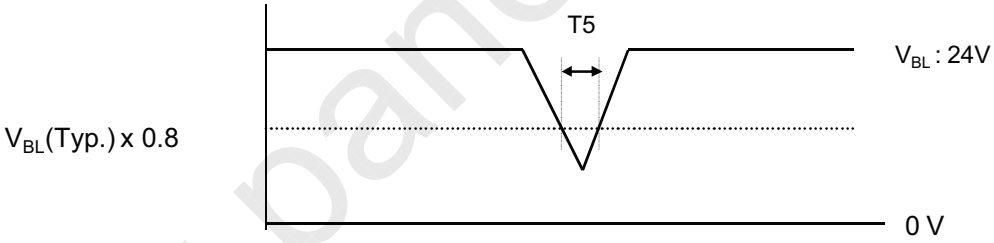


Table 10. Power Sequence for LED Driver

Parameter	Values			Units	Remarks
	Min	Typ	Max		
T1	20	-	-	ms	1
T2	500	-	-	ms	
T3	10		-	ms	
T4	0	-	-	ms	
T5	-	-	10	ms	V_{BL}(Typ) x 0.8

notes : 1. T1 describes rising time of 0V to 24V and this parameter does not applied at restarting time.
Even though T1 is over the specified value, there is no problem if I^2T spec of fuse is satisfied.

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4. Optical Specification

Optical characteristics are determined after the unit has been 'ON' and stable in a dark environment at 25±2°C. The values are specified at distance 50cm from the LCD surface at a viewing angle of Φ and θ equal to 0 °. FIG. 1 shows additional information concerning the measurement equipment and method.

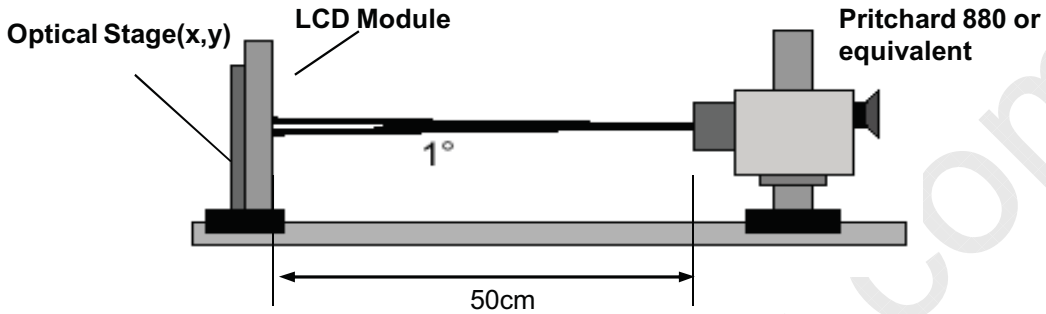

FIG. 1 Optical Characteristic Measurement Equipment and Method

Ta= 25±2°C, V_{LCD}=12.0V, fv=120Hz, Dclk=74.25MHz, **EXTV**BR-B =100%

Table 11. OPTICAL CHARACTERISTICS

Parameter		Symbol	Value			Unit	notes
			Min	Typ	Max		
Contrast Ratio		CR	1100(TBD)	1600(TBD)	-		1
Surface Luminance, white		L_{WH}	280	350		cd/m^2	2
Luminance Variation		δ_{WHITE} 5P			1.4		3
Response Time	Gray-to-Gray	G to G	-	5	8	ms	4
	MPRT	MPRT	-	8	12		5
	Uniformity	δ_{MPRT}	-	-	1		5
	Uniformity	$\delta_{G\ TO\ G}$	-	-	1		5
Color Coordinates [CIE1931]	RED	Rx	Typ -0.03	0.645	Typ +0.03		
		Ry		0.335			
	GREEN	Gx		0.305			
		Gy		0.610			
	BLUE	Bx		0.150			
		By		0.060			
	WHITE	Wx		0.279			
		Wy		0.292			
Color Temperature				10,000		K	
Color Gamut				72		%	
Viewing Angle (CR >10)	right(ϕ=0°)	θr (x axis)	89	-	-	degree	6
	left (ϕ=180°)	θl (x axis)	89	-	-		
	up (ϕ=90°)	θu (y axis)	89	-	-		
	down (ϕ=270°)	θd (y axis)	89	-	-		
Gray Scale			-	-	-		7

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notes : 1. Contrast Ratio(CR) is defined mathematically as :

$$\text{Contrast Ratio} = \frac{\text{Surface Luminance with all white pixels}}{\text{Surface Luminance with all black pixels}}$$

It is measured at center 1-point.

2. Surface luminance is determined after the unit has been 'ON' and 1 Hour after lighting the backlight in a dark environment at 25±2°C. Surface luminance is the luminance value at center 1-point across the LCD surface 50cm from the surface with all pixels displaying white. For more information see the FIG. 2.

3. The variation in surface luminance , δ WHITE is defined as :
δ WHITE(5P) = Maximum(L_{on1},L_{on2}, L_{on3}, L_{on4}, L_{on5}) / Minimum(L_{on1},L_{on2}, L_{on3}, L_{on4}, L_{on5})
Where L_{on1} to L_{on5} are the luminance with all pixels displaying white at 5 locations .
For more information, see the FIG. 2.

4. Response time is the time required for the display to transit from G(N) to G(M) (Rise Time, Tr_R) and from G(M) to G(N) (Decay Time, Tr_D). For additional information see the FIG. 3. (N<M)
※ G to G Spec stands for average value of all measured points.
Photo Detector : RD-80S / Field : 2˚

5. MPRT is defined as the 10% to 90% blur-edge width Bij(pixels) and scroll speed U(pixels/frame)at the moving picture. For more information, see FIG 4

※. Gray to Gray / MPRT Response time uniformity is Reference data. Appendix VI-1/ VI-2

6. Viewing angle is the angle at which the contrast ratio is greater than 10. The angles are determined for the horizontal or x axis and the vertical or y axis with respect to the z axis which is normal to the LCD module surface. For more information, see the FIG. 5.

7. Gray scale specification
Gamma Value is approximately 2.2. For more information, see the Table 12.

Table 12. GRAY SCALE SPECIFICATION

Gray Level	Luminance [%] (Typ)
L0	0.06
L63	0.27
L127	1.04
L191	2.49
L255	4.68
L319	7.66
L383	11.5
L447	16.1
L511	21.6
L575	28.1
L639	35.4
L703	43.7
L767	53.0
L831	63.2
L895	74.5
L959	86.7
L1023	100

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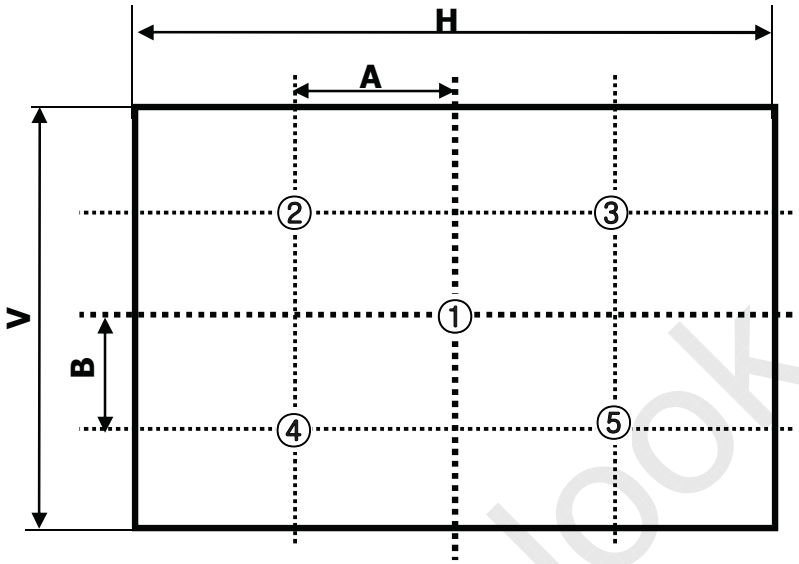
Measuring point for surface luminance & measuring point for luminance variation.



A : H / 4 mm
B : V / 4 mm
@ H,V : Active Area

FIG. 2 5 Points for Luminance Measure

Response time is defined as the following figure and shall be measured by switching the input signal for "Gray(N)" and "Gray(M)".

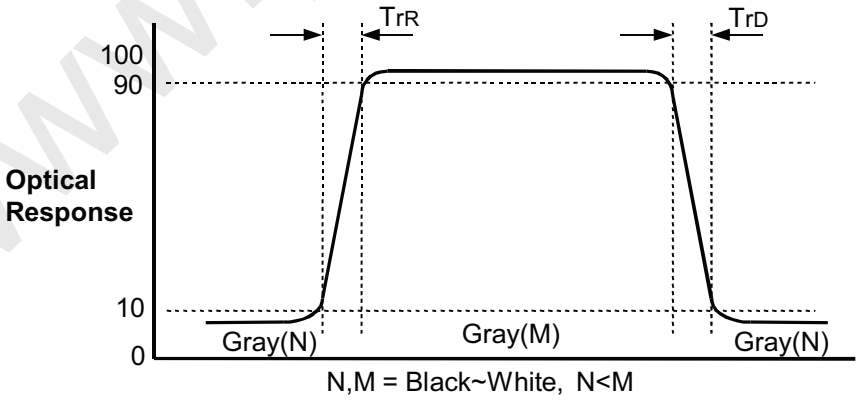


FIG. 3 Response Time

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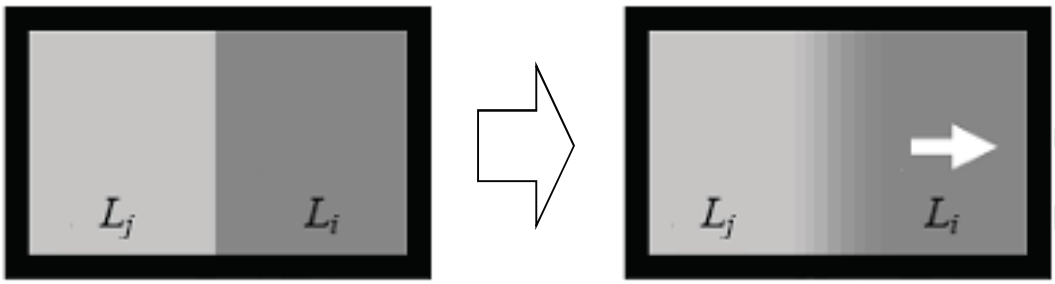
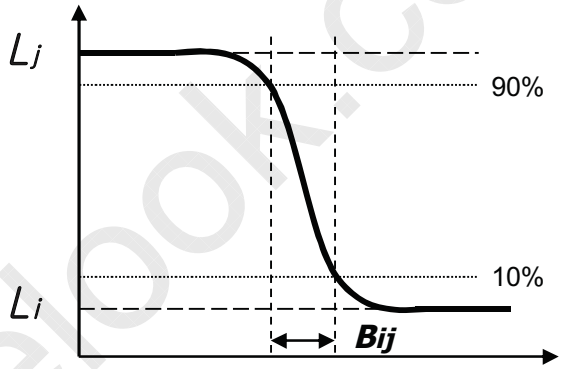
MPRT is defined as the 10% to 90% blur-edge with Bij(pixels) and scroll speed U(pixels/frame)at the moving picture.



$$M = \frac{1}{U} Bij \ (i \neq j)$$



Example) Bij = 12pixels, U = 10pixels / 120Hz
M = 12pixels / (10pixels / 120Hz)
= 12pixels / {10pixels / (1/120)s}
= 12 / 1,200 s
= 10 ms

FIG. 4 MPRT

Dimension of viewing angle range

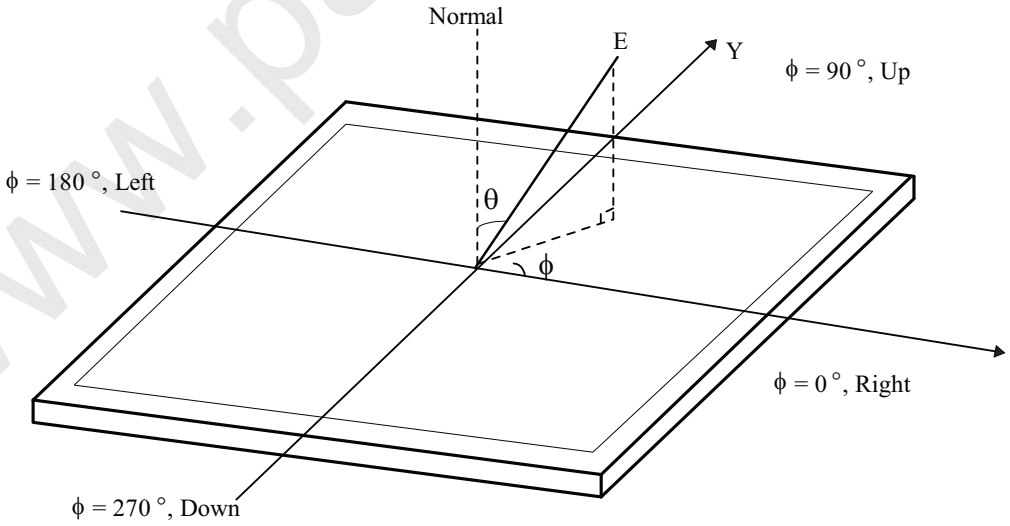


FIG. 5 Viewing Angle

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5. Mechanical Characteristics

Table 13 provides general mechanical characteristics.

Table 13. MECHANICAL CHARACTERISTICS

Item	Value	
Outline Dimension	Horizontal	1904.0 mm
	Vertical	1096.0 mm
	Depth	15.5 mm
Bezel Area	Horizontal	1871.0 mm
	Vertical	1057.0 mm
Active Display Area	Horizontal	1860.48 mm
	Vertical	1046.52 mm
Weight	42.9Kg (Typ.), 44.4 kg (Max.)	

notes : Please refer to a mechanical drawing in terms of tolerance at the next page.

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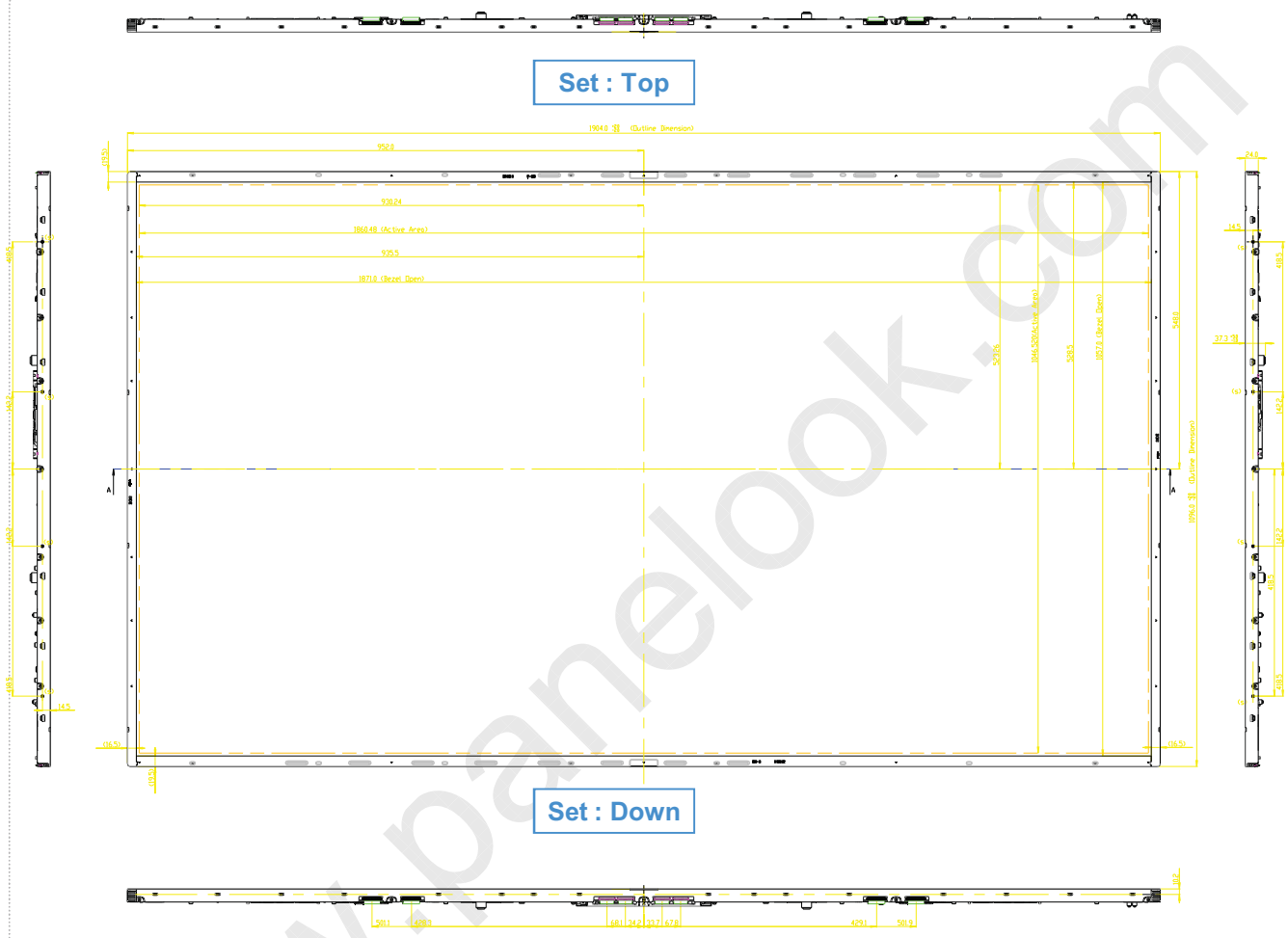
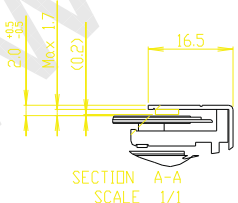
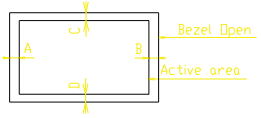
[FRONT VIEW]





NOTES
1. UNSPECIFIED TOLERANCE IS 1.0mm.
2. This drawing is only preliminary data and can be changed without not notice.
3. TILT AND PARTIAL DISPOSITION TOLERANCE OF DISPLAY AREA AS FOLLOWING:
(1) X-DIRECTION : |A-B| ≦ 1.5mm.
(2) Y-DIRECTION : |C-D| ≦ 1.5mm.
4. Designer's approval is required before mass-pro.
5. Screw head max Protrusion : 1.0mm



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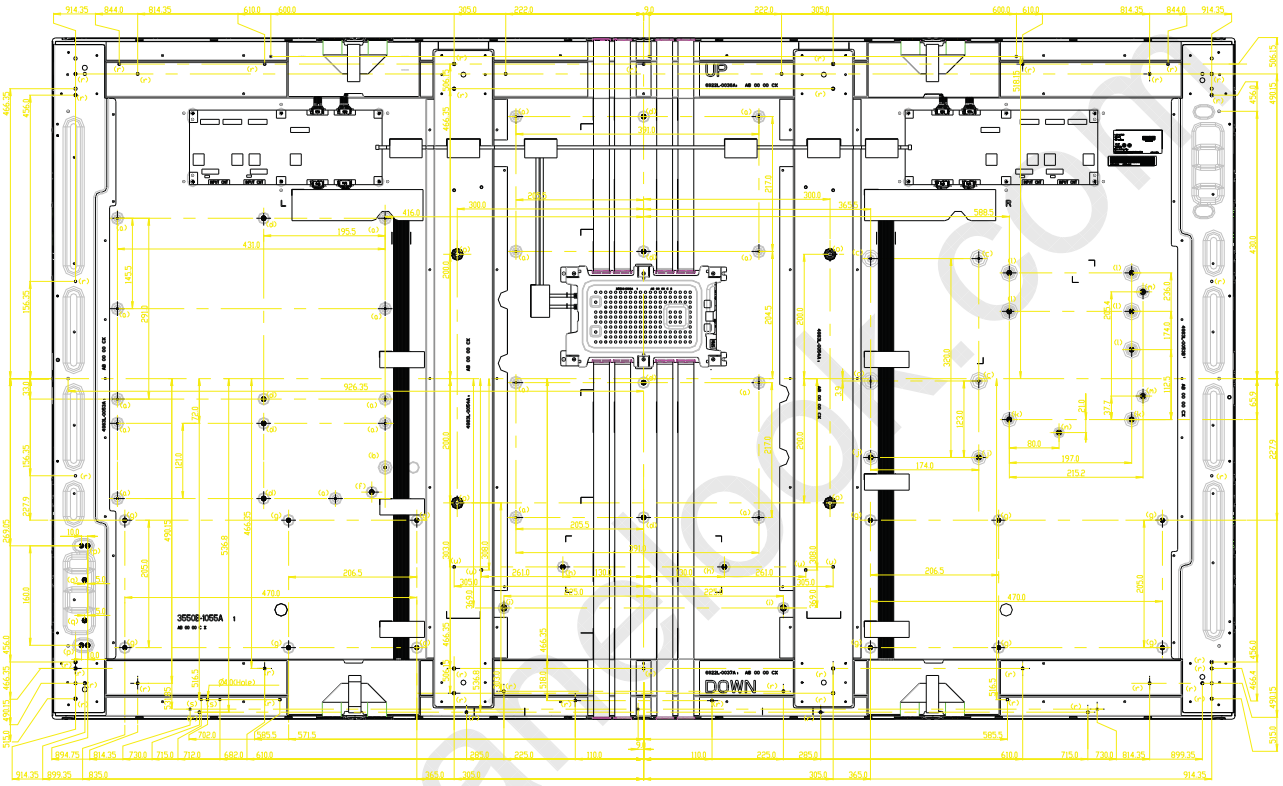
[REAR VIEW]

Set : Top



Set : Down

ITEM	TAP	Depth (mm)	Torque (kgf.cm)	Notes
(a)	M3.0	Max 4.0	5.0	Emboss
(b)	M4.0	Max 4.0	6.0	Emboss
(c)	M3.0	Max 5.5	5.0	Emboss
(d)	M3.0	Max 4.0	8.0	Pem_nut(1)
(f)	M3.0	Max 13.4	8.0	Pem_nut(3)
(g)	M3.0	Max 12.0	8.0	Pem_nut(4)
(h)	M4.0	Max 11.0	10.0	Pem_nut(5)
(i)	M4.0	Max 11.0	10.0	Pem_nut(6)
(j)	M3.0	Max 6.4	8.0	Pem_nut(1)
(k)	M3.0	Max 8.3	8.0	Pem_nut(7)
(l)	M3.0	Max 8.3	8.0	Pem_nut(8)
(m)	M3.0	Max 6.0	8.0	Pem_nut(9)
(n)	M3.0	Max 4.7	8.0	Pem_nut(9)
(o)	M8.0	Max 19.8	12.0	Pem_nut(10)
(p)	M3.0	Max 15.8	8.0	Pem_nut(11)
(q)	M3.0	Max 13.3	8.0	Pem_nut(11)
(r)	M4.0	Max 7.5	6.0	Rear Tap
(s)	M3.0	Max 8.0	5.0	Side Tap(1)
(t)	M3.0	Min7.2~Max 7.6	5.0	Side Tap(2)
(u)	M4.0	Max 6.0	6.0	Center Tap(1)

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6. Reliability

Table 14. ENVIRONMENT TEST CONDITION

No.	Test Item	Condition
1	High temperature storage test	Ta= 60°C 240h
2	Low temperature storage test	Ta= -20°C 240h
3	High temperature operation test	Ta= 50°C 50%RH 240h
4	Low temperature operation test	Ta= 0°C 240h
5	Vibration test (non-operating)	No Guarantee
6	Shock test (non-operating)	No Guarantee
7	Humidity condition Operation	Ta= 40 °C ,90%RH
8	Altitude operating storage / shipment	0 - 15,000 ft 0 - 40,000 ft

notes : Before and after Reliability test, LCM should be operated with normal function.

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7. International Standards

7-1. Safety

a) UL 60065, Underwriters Laboratories Inc.
Audio, Video and Similar Electronic Apparatus - Safety Requirements.

b) CAN/CSA C22.2 No.60065:03, Canadian Standards Association.
Audio, Video and Similar Electronic Apparatus - Safety Requirements.

c) EN 60065, European Committee for Electrotechnical Standardization (CENELEC).
Audio, Video and Similar Electronic Apparatus - Safety Requirements.

d) IEC 60065, The International Electrotechnical Commission (IEC).
Audio, Video and Similar Electronic Apparatus - Safety Requirements.
(Including report of IEC60825-1:2001 clause 8 and clause 9)

notes

1. Laser (LED Backlight) Information

Class 1M LED Product IEC60825-1 : 2001 Embedded LED Power (Class 1M)

2. Caution
: LED inside.
Class 1M laser (LEDs) radiation when open.
Do not open while operating.

7-2. EMC

a) ANSI C63.4 “American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.” American National Standards Institute (ANSI), 2003.

b) CISPR 22 “Information technology equipment – Radio disturbance characteristics – Limit and methods of measurement." International Special Committee on Radio Interference (CISPR), 2005.

c) CISPR 13 “Sound and television broadcast receivers and associated equipment – Radio disturbance characteristics – Limits and method of measurement." International Special Committee on Radio Interference (CISPR), 2006.

7-3. Environment

a) RoHS, Directive 2002/95/EC of the European Parliament and of the council of 27 January 2003

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8. Packing

8-1. Information of LCM Label

a) Lot Mark

A	B	C	D	E	F	G	H	I	J	K	L	M

A,B,C : SIZE(INCH)
D : YEAR
E : MONTH
F ~ M : SERIAL NO.

Note

1. YEAR

Year	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Mark	A	B	C	D	E	F	G	H	J	K

2. MONTH

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mark	1	2	3	4	5	6	7	8	9	A	B	C

b) Location of Lot Mark

Serial NO. is printed on the label. The label is attached to the backside of the LCD module.
This is subject to change without prior notice.

8-2. Packing Form

a) Package quantity in one Pallet : 6 pcs

b) Pallet Size : 2280 mm(W) X 780 mm(D) X 1424 mm(H)

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9. Precautions

Please pay attention to the followings when you use this TFT LCD module.

9-1. Mounting Precautions

(1) You must mount a module using specified mounting holes (Details refer to the drawings).
(2) You should consider the mounting structure so that uneven force (ex. Twisted stress) is not applied to the module. And the case on which a module is mounted should have sufficient strength so that external force is not transmitted directly to the module.
(3) Please attach the surface transparent protective plate to the surface in order to protect the polarizer. Transparent protective plate should have sufficient strength in order to the resist external force.
(4) You should adopt radiation structure to satisfy the temperature specification.
(5) Acetic acid type and chlorine type materials for the cover case are not desirable because the former generates corrosive gas of attacking the polarizer at high temperature and the latter causes circuit break by electro-chemical reaction.
(6) Do not touch, push or rub the exposed polarizers with glass, tweezers or anything harder than HB pencil lead. And please do not rub with dust clothes with chemical treatment.
Do not touch the surface of polarizer for bare hand or greasy cloth.(Some cosmetics are detrimental to the polarizer.)
(7) When the surface becomes dusty, please wipe gently with absorbent cotton or other soft materials like chamois soaks with petroleum benzine. Normal-hexane is recommended for cleaning the adhesives used to attach front / rear polarizers. Do not use acetone, toluene and alcohol because they cause chemical damage to the polarizer
(8) Wipe off saliva or water drops as soon as possible. Their long time contact with polarizer causes deformations and color fading.
(9) Do not open the case because inside circuits do not have sufficient strength.

9-2. Operating Precautions

(1) Response time depends on the temperature.(In lower temperature, it becomes longer.)
(2) Brightness depends on the temperature. (In lower temperature, it becomes lower.)
And in lower temperature, response time(required time that brightness is stable after turned on) becomes longer
(3) Be careful for condensation at sudden temperature change.Condensation makes damage to polarizer or electrical contacted parts. And after fading condensation, smear or spot will occur.
(4) When fixed patterns are displayed for a long time, remnant image is likely to occur.
(5) Module has high frequency circuits. Sufficient suppression to the electromagnetic interference shall be done by system manufacturers. Grounding and shielding methods may be important to minimized the interference.
(6) Please do not give any mechanical and/or acoustical impact to LCM. Otherwise, LCM can't be operated its full characteristics perfectly.
(7) A screw which is fastened up the steels should be a machine screw.
(if not, it can causes conductive particles and deal LCM a fatal blow)
(8) Please do not set LCD on its edge.
(9) The conductive material and signal cables are kept away from LED driver inductor to prevent abnormal display, sound noise and temperature rising.

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9-3. Electrostatic Discharge Control

Since a module is composed of electronic circuits, it is not strong to electrostatic discharge. Make certain that treatment persons are connected to ground through wrist band etc. And don't touch interface pin directly.

9-4. Precautions for Strong Light Exposure

Strong light exposure causes degradation of polarizer and color filter.

9-5. Storage

When storing modules as spares for a long time, the following precautions are necessary.

(1) Store them in a dark place. Do not expose the module to sunlight or fluorescent light. Keep the temperature between 5°C and 35°C at normal humidity.
(2) The polarizer surface should not come in contact with any other object.
It is recommended that they be stored in the container in which they were shipped.
(3) Storage condition is guaranteed under packing conditions.
(4) The phase transition of Liquid Crystal in the condition of the low or high storage temperature will be recovered when the LCD module returns to the normal condition

9-6. Handling Precautions for Protection Film

(1) The protection film is attached to the bezel with a small masking tape.
When the protection film is peeled off, static electricity is generated between the film and polarizer.
This should be peeled off slowly and carefully by people who are electrically grounded and with well ion-blown equipment or in such a condition, etc.
(2) When the module with protection film attached is stored for a long time, sometimes there remains a very small amount of glue still on the bezel after the protection film is peeled off.
(3) You can remove the glue easily. When the glue remains on the bezel surface or its vestige is recognized, please wipe them off with absorbent cotton waste or other soft material like chamois soaked with normal-hexane.

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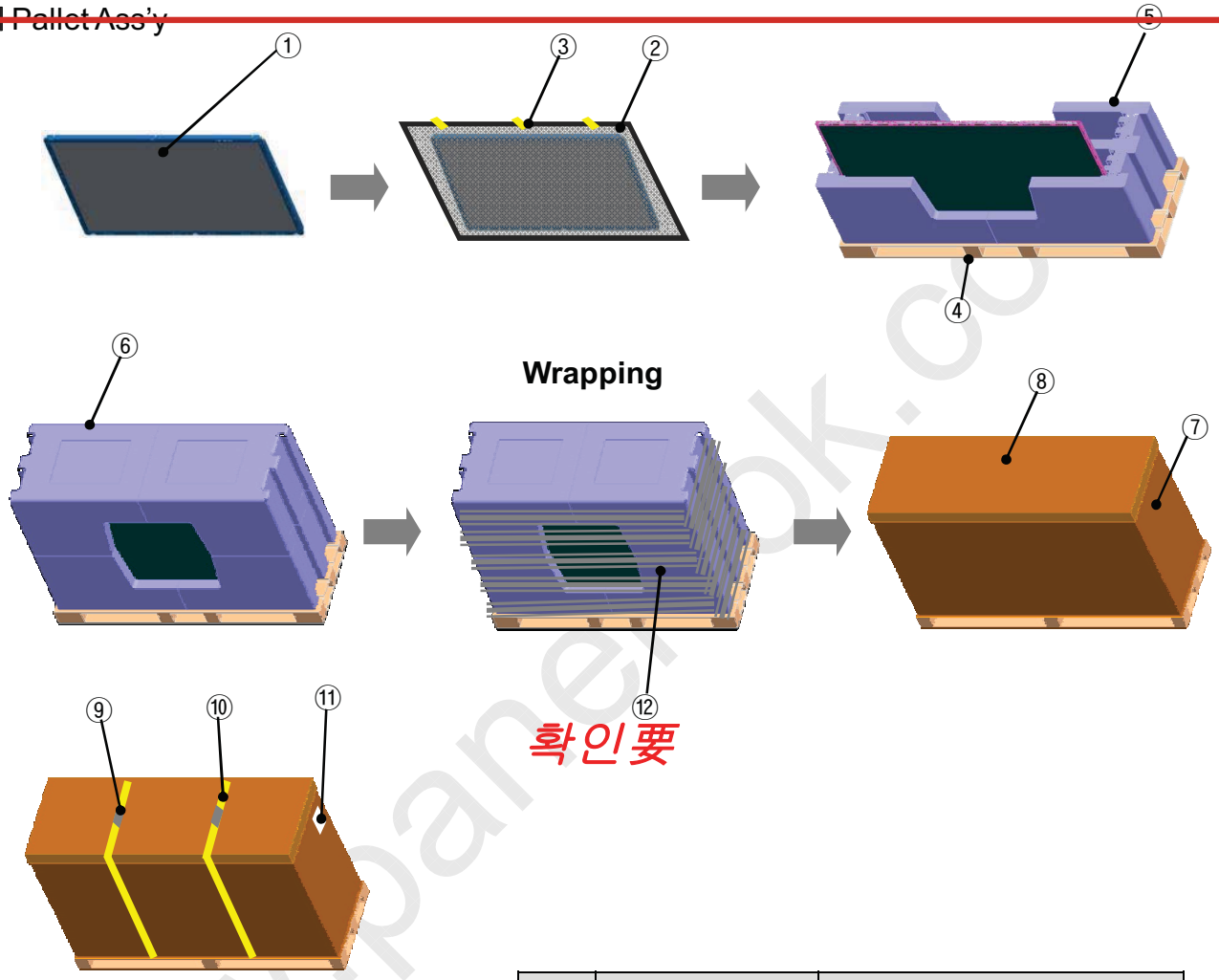
APPENDIX-I

■ Pallet Ass'y



NO	DESCRIPTION	MATERIAL
1	LCD Module	84" LCD
2	BAG	AL Bag
3	TAPE	MASKING 20MM X 50M
4	PALLET	Plywood (2280X780X125)
5	PACKING	EPS
6	PACKING	EPS
7	ANGLE PACKING	PAPER
8	ANGLE COVER	PAPER
9	BAND,CLIP	STEEL
10	BAND	PP
11	LABEL	YUPO PAPER 80G 100X100
12	Wrap	LLDPE

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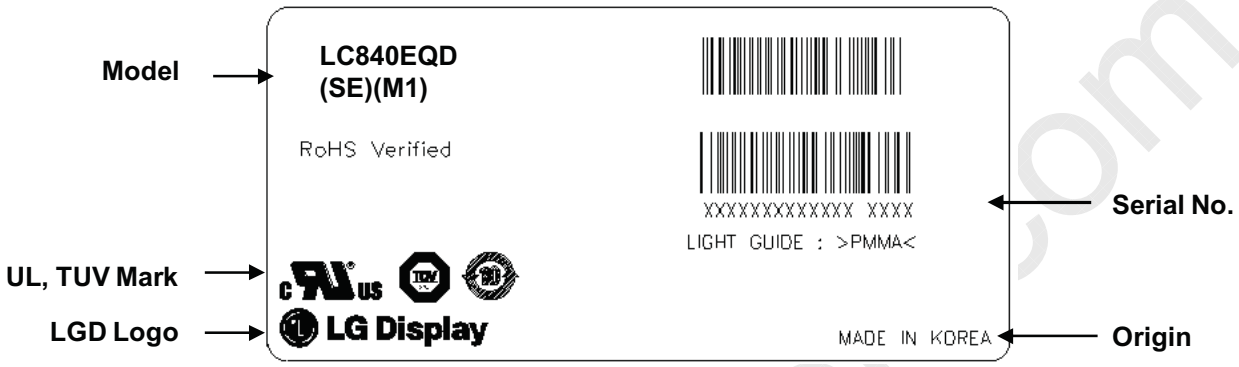
APPENDIX- II-1

■ LCM Label



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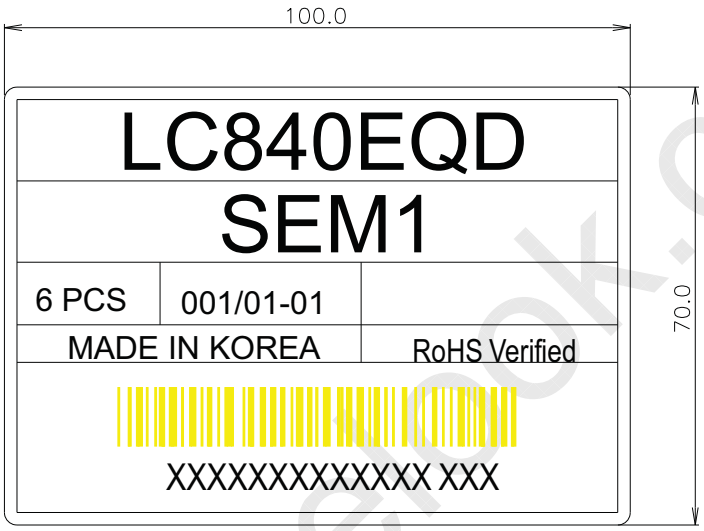
 # APPENDIX- II-2

■ Pallet Label



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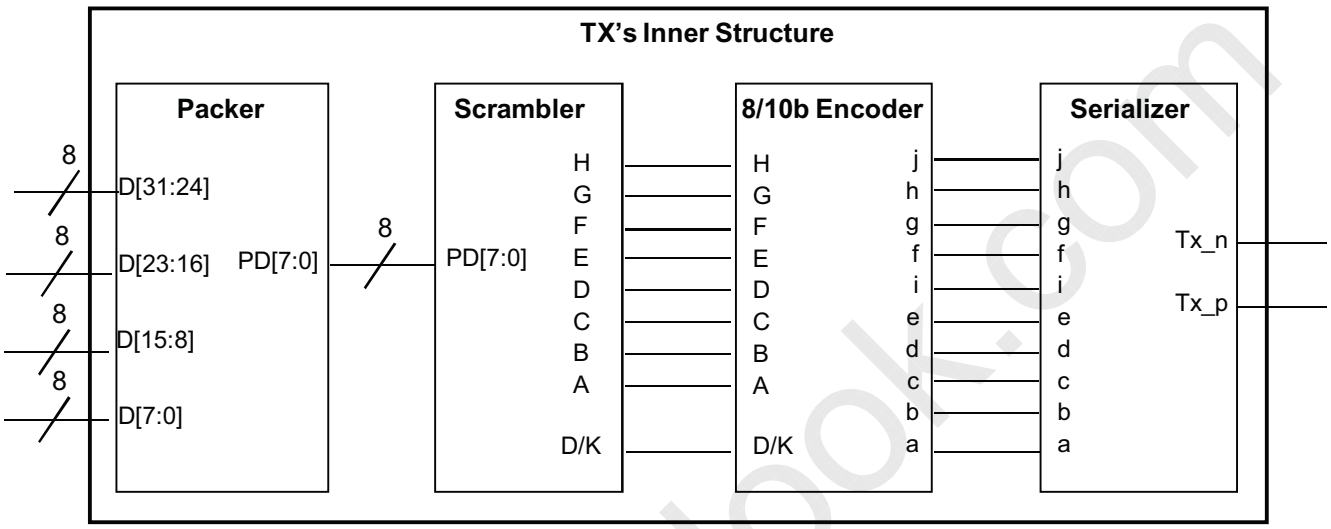
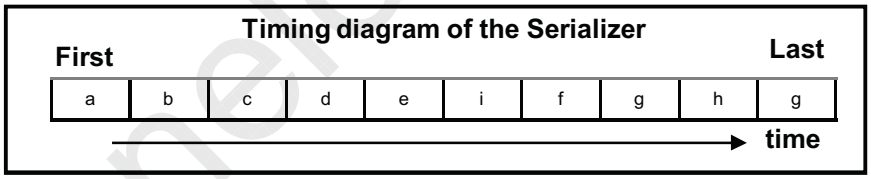
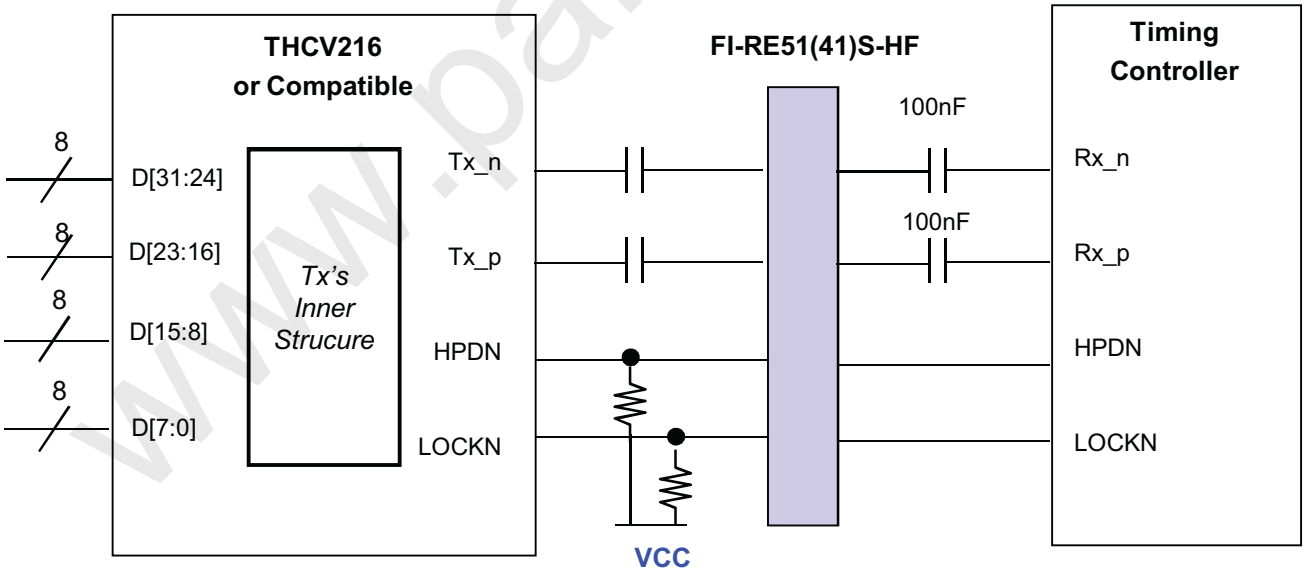
APPENDIX- III-1

■ Required signal assignment for Flat Link (Thine : THCV216) Transmitter







notes: 1. The LCD module uses a 100 nF capacitor on positive and negative lines of each receiver input.
2. Refer to Vx1 Transmitter Data Sheet for detail descriptions. (THCV216 or Compatible)
3. About Module connector pin configuration, Please refer to the Page 8~9.

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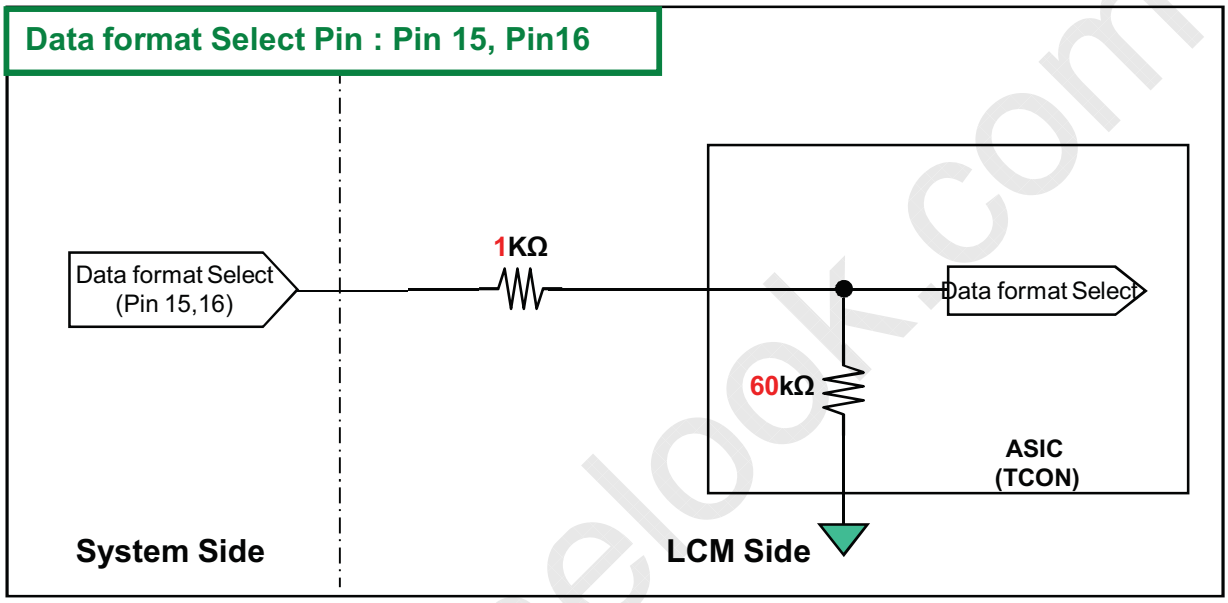
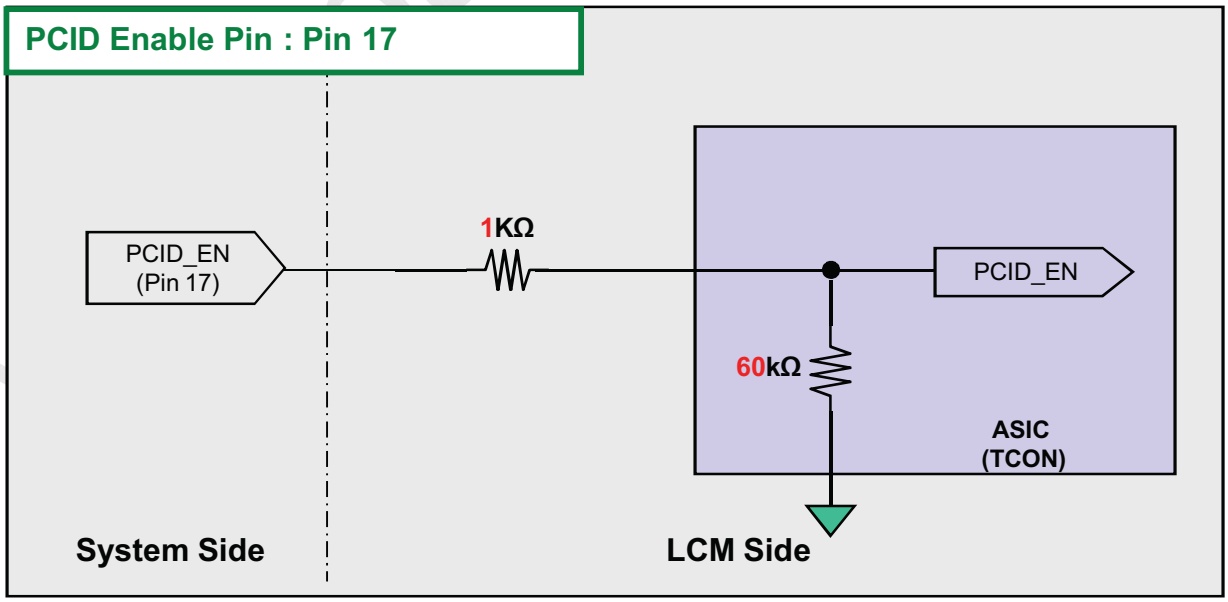
APPENDIX- IV-1

■ **Option Pin** Circuit Block Diagram

1) Circuit Block Diagram of Data format Selection pin



2) Circuit Block Diagram of **L-DIM Enable** Selection pin



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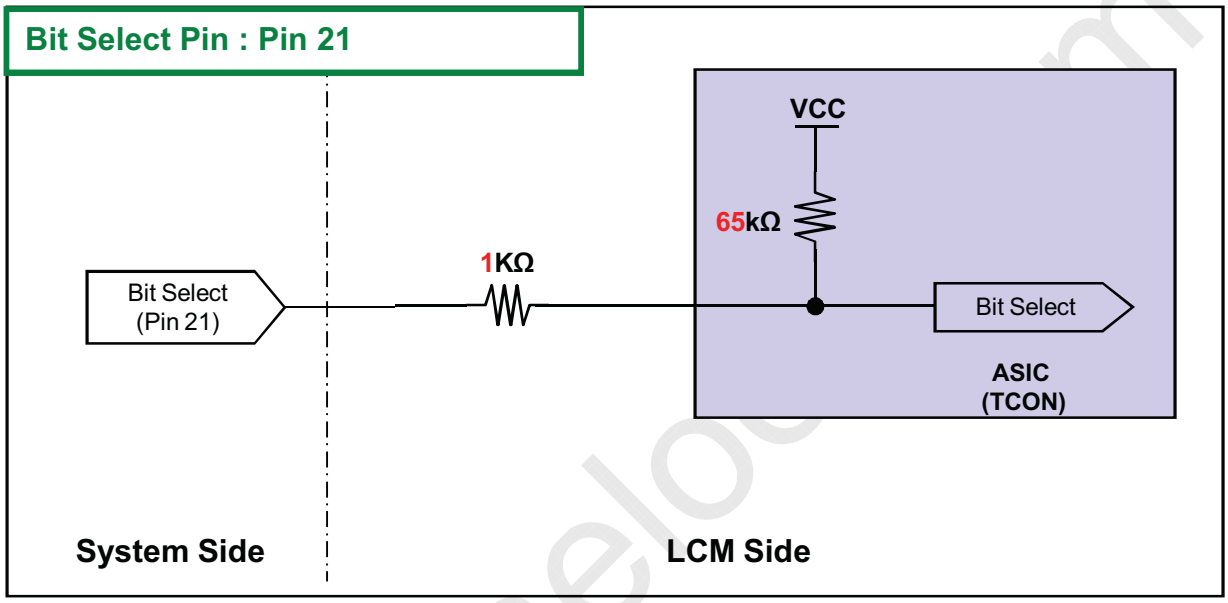
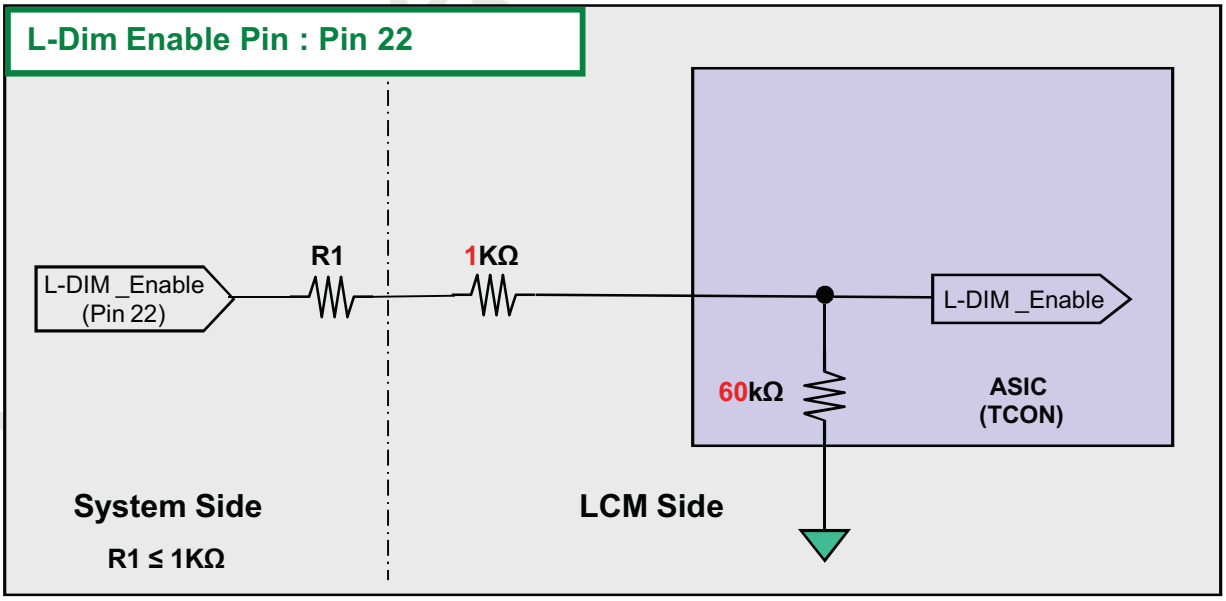
APPENDIX- IV-2

■ **Option Pin** Circuit Block Diagram

3) Circuit Block Diagram of Bit Selection pin



4) Circuit Block Diagram of L-Dim **Enable** Selection pin



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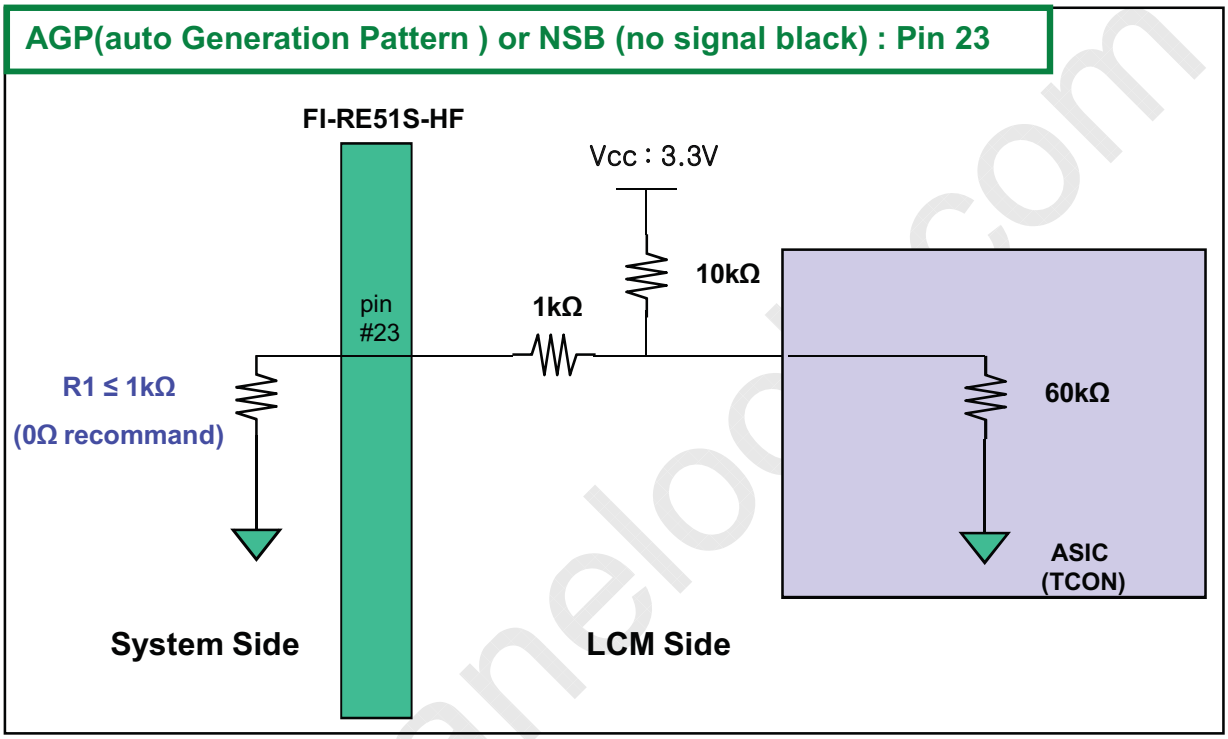
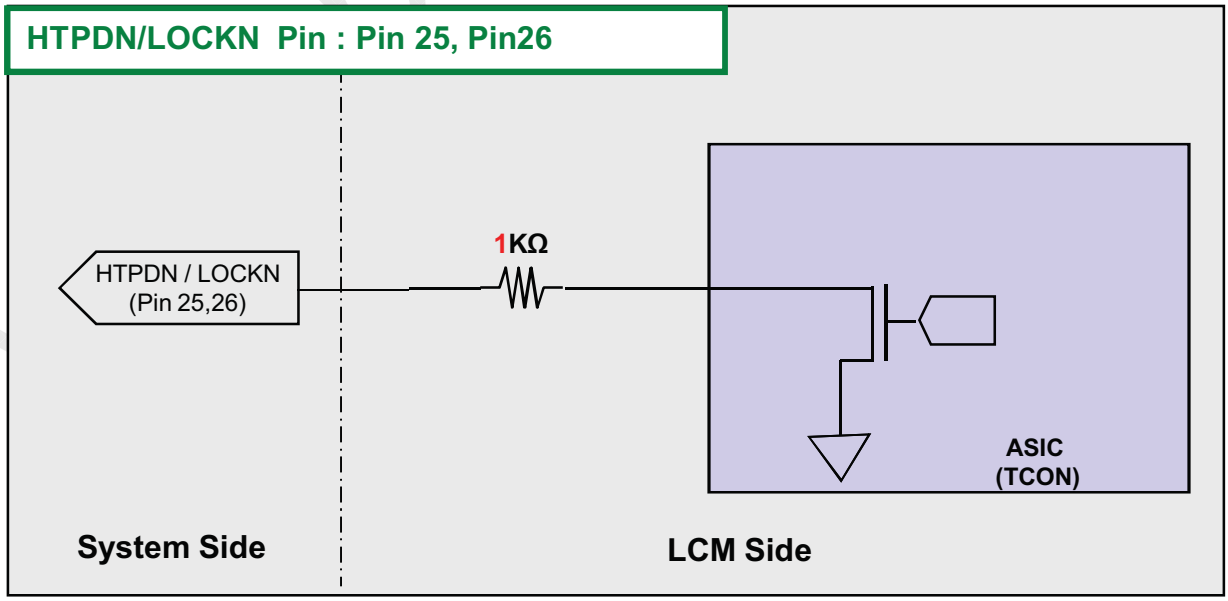
APPENDIX- IV-3

■ Option Pin Circuit Block Diagram

5) Circuit Block Diagram of HTPDN/ LOCKN Selection pin



7) Circuit Block Diagram of HTPDN/ LOCKN Selection pin



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APPENDIX- V

■ EXTVBR-B & Local Dimming Design Guide

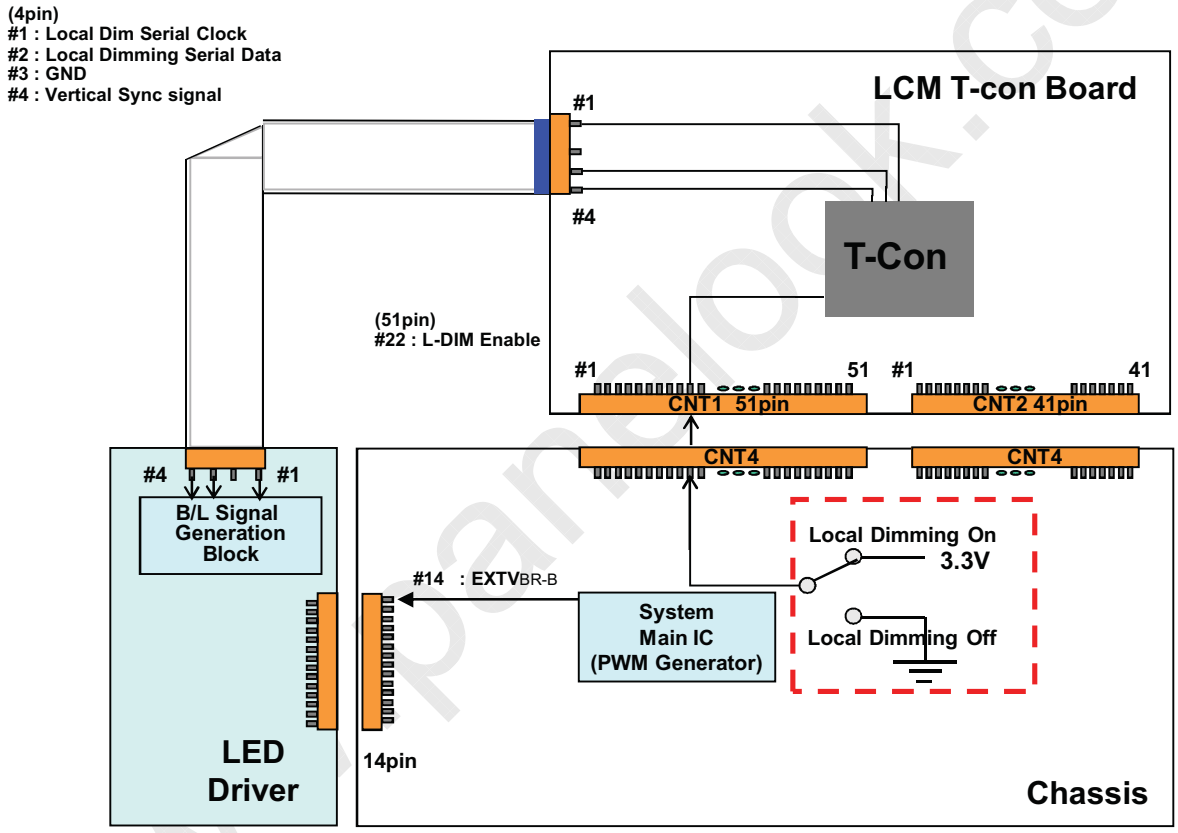
1) When L-Dim Enable is "L", Vertical Sync Signal = System Dimming with 100Hz or 120Hz frequency.

2) Local Dimming signals are synchronized with V-Sync Freq. of System in T-Con Board.

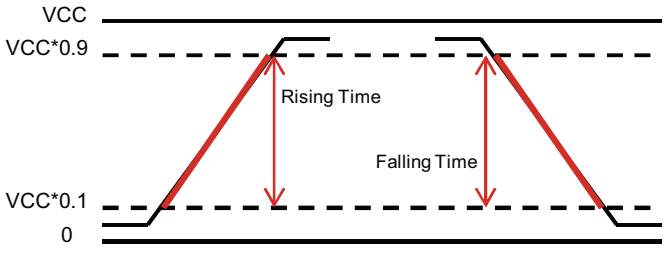
3) EXTVBR-B Specification (VCC = 3.3V) @ Local Dimming

a) High Voltage Range : 2.5 V ~ 3.6 V

b) Low Voltage Range : 0.0 V ~ 0.8 V



EXTVBR-B Frequency	100 Hz for PAL 120 Hz for NTSC
Rising Time	MAX 10.0 μs
Falling Time	MAX 10.0 μs



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APPENDIX- VI-1

Gray to Gray Response Time Uniformity

This is only the reference data of G to G and uniformity for LC840EQD-SEM1 model.

1. G to G Response Time :
   Response time is defined as Figure3 and shall be measured by switching the input signal for "Gray (N) " and "Gray(M)".(32Gray Step at 8bit)

2. G to G Uniformity
   The variation of G to G Uniformity , $\delta_{G\ to\ G}$ is defined as :

$$\text{G to G Uniformity} = \frac{Maximum(GtoG) - Typical(GtoG)}{Typical(GtoG)} \leq 1$$

*Maximum (G to G) means maximum value of measured time (N, M = 0 (Black) ~ 1023(White), 128 gray step).

	0Gray	127ray	255Gray	…	895Gray	1023Gray
0Gray		TrR:0G→127G	TrR:0G→255G	…	TrR:0G→895G	TrR:0G→1023G
127Gray	TrD:127G→0G		TrR:127G→255G	…	TrR:127G→895G	TrR:127G→1023G
255Gray	TrD:255G→0G	TrD:255G→127G		…	TrR:255G→895G	TrR:255G→1023G
…	…	…	…		…	…
895Gray	TrD:895G→0G	TrD:895G→127G	TrD:895G→255G	…		TrR:895G→1023G
1023Gray	TrD:1023G→0G	TrD:1023G→127G	TrD:1023G→255G	…	TrD:1023G→895G	

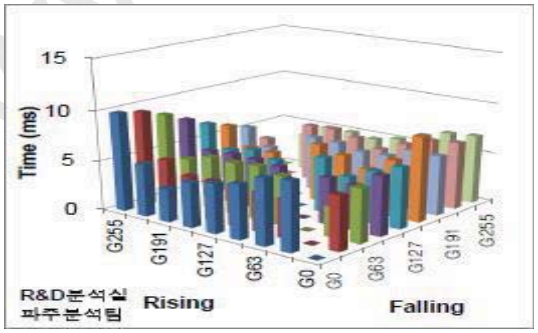
3. Sampling Size : 2 pcs

4. Measurement Method : Follow the same rule as optical characteristics measurement.

5. Current Status

   Below table is actual data of production on July. 01**. 2012 (LGD RV Event Sample)**

	G to G Response Time [ms]		Uniformity
	Min.	Max.	
# 1	2.97	9.32	0.74
# 2	3.44	8.19	0.69



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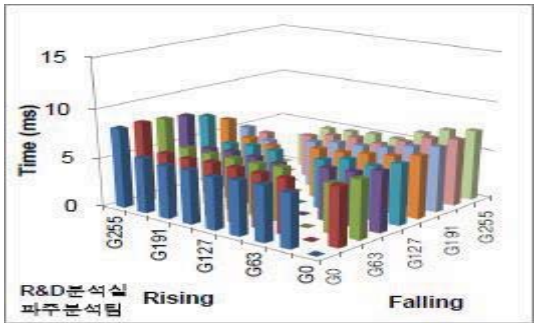

< # 2 >

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APPENDIX- VI-2

■ MPRT Response Time Uniformity (δ_{MPRT})

This is only the reference data of MPRT and uniformity for LC840EQD-SEM1 model.

1. MPRT Response Time :
   Response time is defined as Figure3

2. MPRT Uniformity
   The variation of MPRT Uniformity , δ_{MPRT} is defined as :

$$\text{MPRT Uniformity} = \frac{Maximum\ (MPRT) - Typical\ (MPRT)}{Typical\ (MPRT)} \leq 1$$

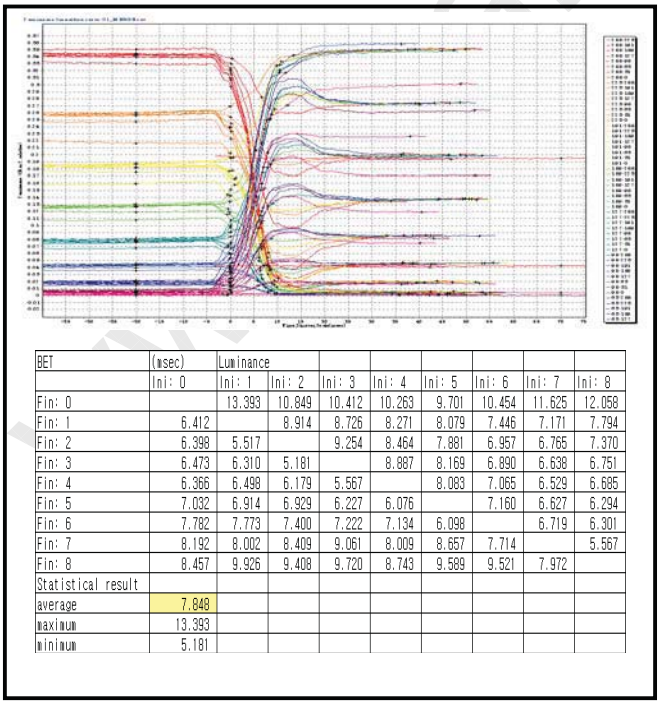
3. Sampling Size : 2 pcs

4. Measurement Method : Follow the same rule as optical characteristics measurement.

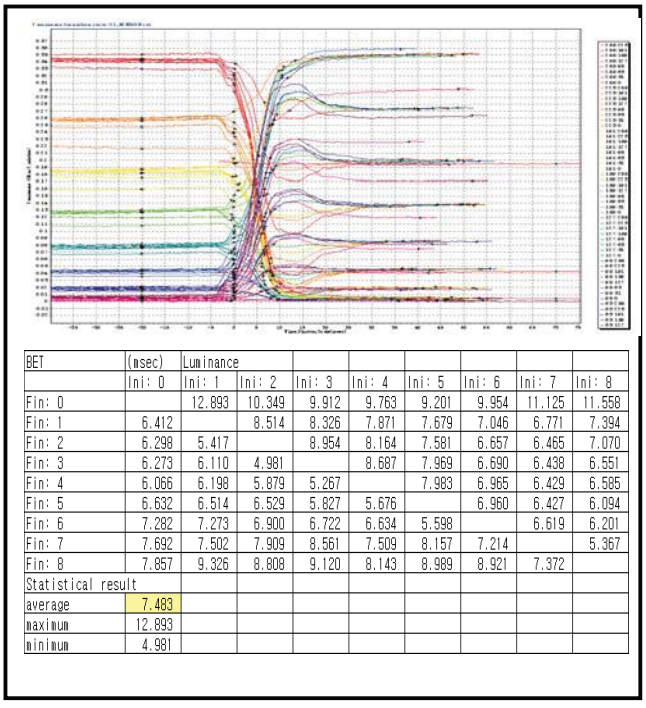
5. Current Status

   Below table is actual data of production on July**. 03. 2012 (LGD RV Event Sample)**

Sample	MPRT Response Time [ms]		Uniformity
	Min.	Max.	
# 1	5.181	13.393	0.68
# 2	4.981	12.893	0.71



BET	(msec)	Luminance							
	Ini: 0	Ini: 1	Ini: 2	Ini: 3	Ini: 4	Ini: 5	Ini: 6	Ini: 7	Ini: 8
Fin: 0		13.393	10.849	10.412	10.263	9.701	10.454	11.625	12.058
Fin: 1	6.412		8.914	8.726	8.271	8.079	7.446	7.171	7.794
Fin: 2	6.398	5.517		9.254	8.464	7.881	6.957	6.765	7.370
Fin: 3	6.473	6.310	5.181		8.887	8.169	6.890	6.638	6.751
Fin: 4	6.366	6.498	6.179	5.567		8.083	7.065	6.529	6.685
Fin: 5	7.032	6.914	6.929	6.227	6.076		7.160	6.627	6.294
Fin: 6	7.782	7.773	7.400	7.222	7.134	6.098		6.719	6.301
Fin: 7	8.192	8.002	8.409	9.061	8.009	8.657	7.714		5.567
Fin: 8	8.457	9.926	9.408	9.720	8.743	9.589	9.521	7.972	
Statistical result									
average	7.848								
maximum	13.393								
minimum	5.181								



BET	(msec)	Luminance							
	Ini: 0	Ini: 1	Ini: 2	Ini: 3	Ini: 4	Ini: 5	Ini: 6	Ini: 7	Ini: 8
Fin: 0		12.893	10.349	9.912	9.763	9.201	9.954	11.125	11.558
Fin: 1	6.412		8.514	8.326	7.871	7.679	7.046	6.771	7.394
Fin: 2	6.298	5.417		8.954	8.164	7.581	6.657	6.465	7.070
Fin: 3	6.273	6.110	4.981		8.687	7.969	6.690	6.438	6.551
Fin: 4	6.066	6.198	5.879	5.267		7.983	6.965	6.429	6.585
Fin: 5	6.632	6.514	6.529	5.827	5.676		6.960	6.427	6.094
Fin: 6	7.282	7.273	6.900	6.722	6.634	5.598		6.619	6.201
Fin: 7	7.692	7.502	7.909	8.561	7.509	8.157	7.214		5.367
Fin: 8	7.857	9.326	8.808	9.120	8.143	8.989	8.921	7.372	
Statistical result									
average	7.483								
maximum	12.893								
minimum	4.981								

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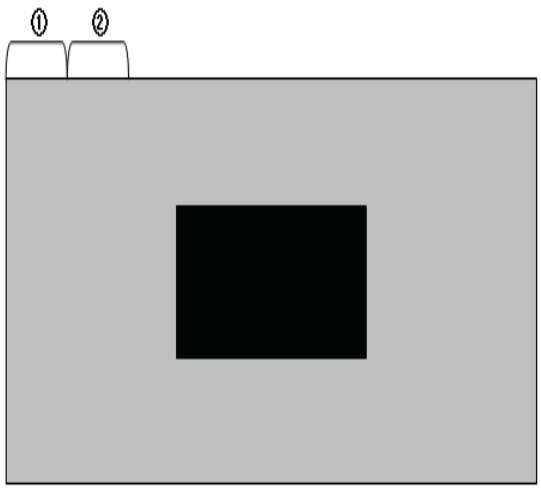
APPENDIX- VII-1

■ input mode of pixel data

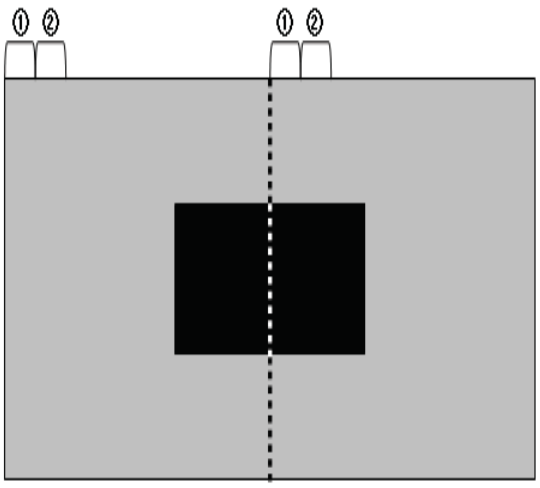
Mode 1: 화면분할 없음.



	1st Data	2nd Data	Data #
Lane00	1	17	3825
Lane01	2	18	3826
Lane02	3	19	3827
Lane03	4	20	3828
Lane04	5	21	3829
Lane05	6	22	3830
Lane06	7	23	3831
Lane07	8	24	3832

	1st Data	2nd Data	Data #
Lane08	9	25	3833
Lane09	10	26	3834
Lane10	11	27	3835
Lane11	12	28	3836
Lane12	13	29	3837
Lane13	14	30	3838
Lane14	15	31	3839
Lane15	16	32	3840

Mode 2: 화면 2분할.



	1st Data	2nd Data	Data #
Lane00	1	9	1913
Lane01	2	10	1914
Lane02	3	11	1915
Lane03	4	12	1916
Lane04	5	13	1917
Lane05	6	14	1918
Lane06	7	15	1919
Lane07	8	16	1920

	1st Data	2nd Data	Data #
Lane08	1921	1929	3833
Lane09	1922	1930	3834
Lane10	1923	1931	3835
Lane11	1924	1932	3836
Lane12	1925	1933	3837
Lane13	1926	1934	3838
Lane14	1927	1935	3839
Lane15	1928	1936	3840

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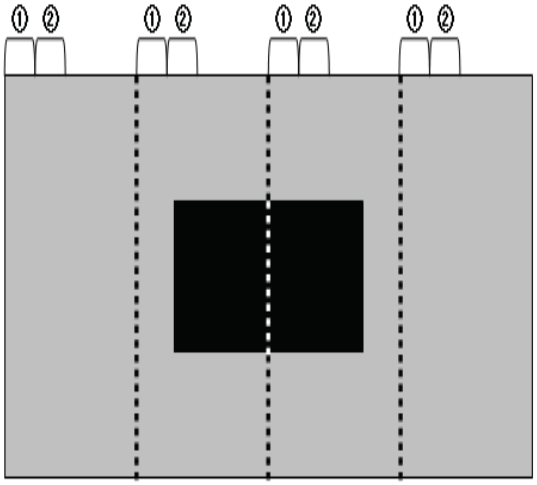
APPENDIX- VII-2

■ input mode of pixel data

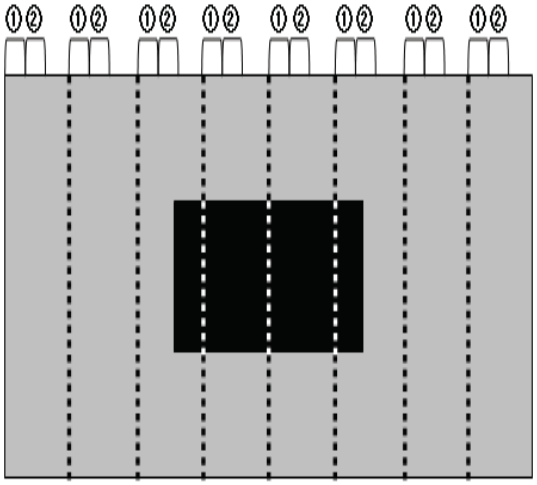
Mode 3: 화면 4분할



	1st Data	2nd Data	Data #
Lane00	1	5	957
Lane01	2	6	958
Lane02	3	7	959
Lane03	4	8	960
Lane04	961	965	1917
Lane05	962	966	1918
Lane06	963	967	1919
Lane07	964	968	1920

	1st Data	2nd Data	Data #
Lane08	1921	1925	2877
Lane09	1922	1926	2878
Lane10	1923	1927	2879
Lane11	1924	1928	2880
Lane12	2881	2885	3837
Lane13	2882	2886	3838
Lane14	2883	2887	3839
Lane15	2884	2888	3840

Mode 4: 화면 8분할.



	1st Data	2nd Data	Data #
Lane00	1	3	479
Lane01	2	4	480
Lane02	481	483	959
Lane03	482	484	960
Lane04	961	963	1439
Lane05	962	964	1440
Lane06	1441	1443	1919
Lane07	1442	1444	1920

	1st Data	2nd Data	Data #
Lane08	1921	1923	2399
Lane09	1922	1924	2400
Lane10	2401	2403	2879
Lane11	2402	2404	2880
Lane12	2881	2883	3359
Lane13	2882	2884	3360
Lane14	3361	3363	3839
Lane15	3362	3364	3840

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